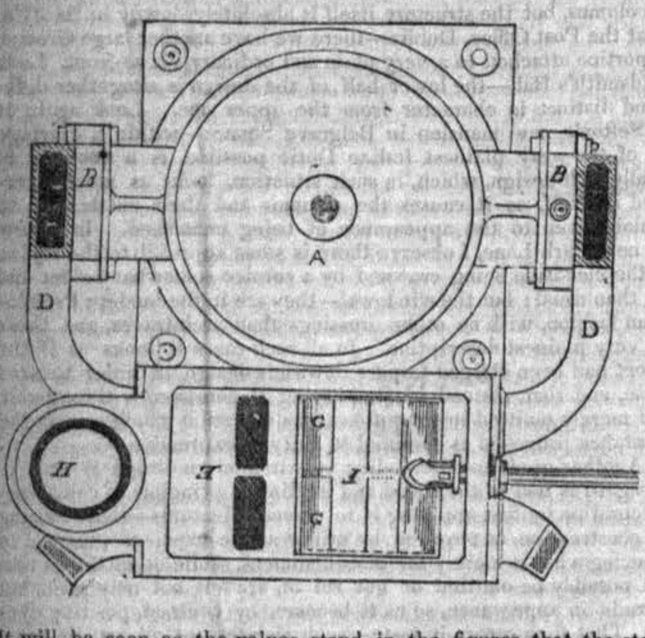
ON REVERSING OF ENGINES.

Sir—When we look to the methods of reversing the motion of reciprocating steam engines which have hitherto been generally adopted, it becomes a matter of surprise that, whilst in almost all patents for rotary engines, where it has been considered the motion would want reversing, it has been done on the principle of changing the steam induction and eduction passages, (*i. e.* what is the induction for one way is made the eduction the other, and *vice versâ*), the same principle has not been adopted for them. The most general and simple way of changing the passages in rotary engines has been by means of the common slide valve, and my object in now addressing you is to propose the adoption of the same slide valve to the reciprocating engine.

The accompanying figures represent it as applied to a pair of marine engines, for which it seems particularly suited. Let A in the figures represent the cylinder; B B B B, valve boxes fitted with stop valves v v v v, almost similar to those of Messrs. Seaward's patent, except that both the valves and boxes are faced on both sides; C 1, C 2, communication pipes to each pair of boxes; D D, branch pipes from C 2, C 1, to the apertures in the slide valve box E; being alternately steam and exhaust as their respective apertures may be covered by the slide valve F; G is the exhaust or eduction to the condenser; H the induction or steam-pipe from the boiler. The valves strike simultaneously (as Seaward's), and are like them worked by one fast eccentric.

Fig. 1.—Plan of Cylinder.



It will be seen as the valves stand in the figures that the steam passing down H into the valve box E, and down the uncovered apertures to communicating pipe C 1, finds the upper aperture stopped up, it consequently makes its way through the lower one and forces up the piston, at the same time the upper valve on the other side of the cylinder is open, and a vacuum being formed in the condenser, it exhausts G, under F, the branch to and the communicating pipe C 2, and the portion of the cylinder above the piston.

If we wish now to reverse the motion, we have only to push the valve F to the other end of the box, as represented by dotted lines in fig. 3, the branch pipe, and C 1 is open to the condenser, and the steam passes down the branch into C 2, and presses down the piston.

The mode of operation will I think be now understood. Fig. 4 is a view of the valve F, as proposed for a pair of engines, showing the midfeather to separate the exhausts or eductions to the respective condensers. The branch pipes to the other cylinder are shown broken off. There is another use of the valve F, it is a perfect regulator or throttle valve, to stop or regulate the engine by; for it is so constructed that supposing the steam to be shut off by it when running either way, still the exhaust apertures remain entirely open. The simplicity of its action, and its doing away with a considerable number of small moving parts consequent on reversing and management in general, by the present methods are its recommendations, not to mention that one man could manage a pair of the largest engines which have yet navigated the ocean, better than 4 or 6, or even 10 men, to some of our

Fig. 2.—Section of Cylinder.

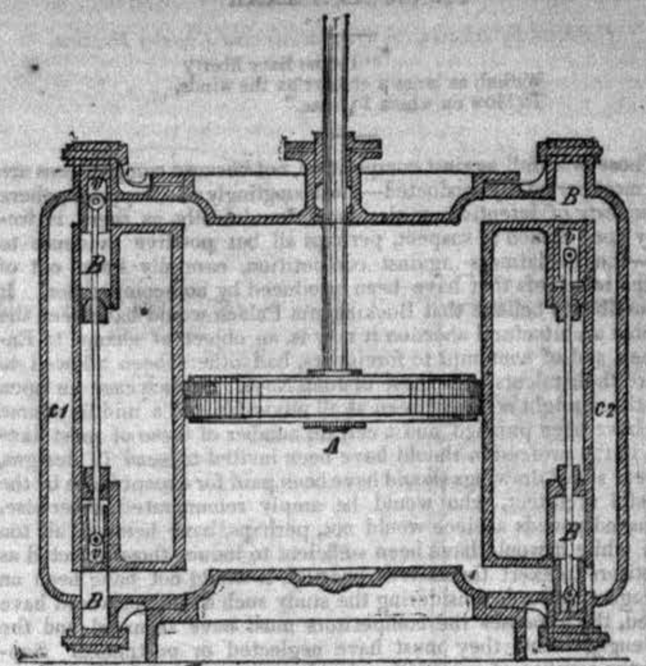


Fig. 3.—Elevation of Cylinder and Section of Valves.

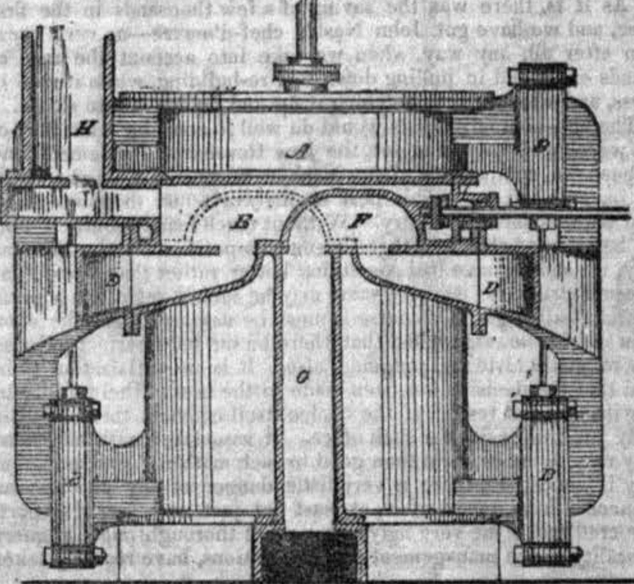


Fig. 4.

present large marine engines. I have a sketch by me, only in pencil as yet, for working locomotives by the same principle, but being so confined as to space, little difficulties present themselves in the arrangement, which a more practical man might soon set aside.

Your's,

G. Coe, Civil Engineer.

Horbury Bridge, near Wakefield,
August 17, 1841.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXI.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. Those who rail against competition, not because competitions are for the most part vilely conducted—most bunglingly also, supposing there to be honesty of intention, or else most fraudulently, as there is frequently good reason to suspect, perhaps all but positive evidence to prove—the declaimers against competition, carefully keep out of sight the mischiefs that have been produced by non-competition. It is impossible to believe that Buckingham Palace would have been the miserable architectural abortion it now is, an object of shame to Englishmen, and of contempt to foreigners, had others been allowed to measure their talents with those of John Nash. In such case an open competition might not have been at all advisable, but a middle course might have been pursued, and a certain number of those of most likelihood in the profession should have been invited to send in designs, and every set of drawings should have been paid for except those by the successful architect, who would be amply remunerated otherwise. A thousand pounds a-piece would not, perhaps, have been at all too much: while it would have been sufficient to induce those selected as competitors to exert themselves heartily, it would not have been an extravagant reward, considering the study such a subject would have required, the expenses the competitors must have incurred, and the other engagements they must have neglected or postponed. Supposing the number of competitors had been ten—it might have been fewer, the £9,000 would not have been recklessly squandered. Even supposing the result had been precisely the same as at present, we should at least have had the satisfaction of knowing that the bauble we have now got was the very best thing of its kind that was to be had. As it is, there was the saving of a few thousands in the first instance, and we have got John Nash's chef-d'œuvre—no very great bargain after all, any way, when we take into account the tens of thousands expended in pulling down and re-building, while it was in progress, and afterwards in botching it up and licking it into shape.

II. The anti-competitionists would do well to consider what sort of design we should have had for the new Houses of Parliament, had there been no competition, but a Nash, a Soane, or a Smirke, been called in, and left to do his best or his worst, and to go on as he pleased without further inquiry. Without much fear of contradiction, it may be affirmed that had there been a competition for the National Gallery, we should have had something better rather than worse than the present structure; and the same may be said in regard to a great many other buildings. Of course it must be assumed that the competition is fairly managed, and that there be not only perfect fairness, but the requisite taste and judgment also. It is no satisfaction to be assured that the decision has been made to the best of their ability by those with whom it rested, if the choice itself convicts them of utter inability and incapacity for such office. If associated with bad taste, honesty may do more harm than good in such matters; yet as far as honesty is concerned, there is very little danger of any mischievous consequences from excess of it, at least not just now, for, if reports may be credited, some very ugly instances of thorough-paced roguery and rascality in the management of competitions, have recently taken place.

III. If no other, there is at least one remarkable peculiarity attending architectural criticism, viz. that so far from endeavouring to be *au courant du jour*, it generally lags most wofully behind-hand, as if it were almost a positive breach of decorum, to discuss the merits of productions belonging to our own times. Why it should be considered requisite to exercise such forbearance towards living architects and their works, more especially, the very reverse of it being frequently manifested in the case of literary men, actors, artists, &c., it is difficult to understand. Neither is such over-delicacy particularly complimentary, since it almost amounts to a confession that it is impossible to speak honestly of the living without also speaking harshly, therefore the critic who would neither give offence nor compromise his own judgment, has no other alternative than silence. On the other hand, however, Brummagem criticism and puffery are allowed to circulate freely enough; for though delicacy may withhold some from giving their opinion unreservedly in the case of architects either living or recently deceased, many there are who do not scruple to cry up almost every thing as a wonder of its kind. With them every goose is a swan, or rather a phœnix. Whatever they are speaking of is, for the time being, superlative of its kind. Their chief merit is their impartiality, since they treat all alike, making no distinction between a Charles Barry and a Richard Brown. Yes, incredible as it may seem, even Professor Brown has his admirers; not long ago a flaring-up puff appeared in a weekly paper on the Professor's "Domestic Architecture," bearing testimony to the value of the work, and the varied talent displayed in the designs, "which would afford to the student examples in every style of building"! Thus a publication which is absolutely pestiferous in taste, and as far as it circulates, is calculated to spread the most vulgar taste throughout the land, not only escapes reprobation, but is actually recommended as an authority and a trustworthy guide. Pity it is that Pugin did not show up some specimens of his brother Professor's designs along with "castellated" firegrates, and similar monstrosities. Should Welby not be yet aware of the existence of Brown's publication, we earnestly recommend it to *him*, for he will find in it some exceedingly piquant tid-bits, *inter alia*, a sample of Egyptian that might very well pass for one of the plagues of Egypt.

IV. Want of keeping is so exceedingly prevalent a fault in architectural design, that it would seem to be the most excusable of any, as being of all others, the one most difficult to be avoided, whereas I should decide precisely the reverse, it being, in my own opinion, one of the most offensive and the least venial, because that which argues the absence of artistical feeling. In every composition there ought to be some leading features, and some parts of a building will very properly bear to be more ornamented than the rest; yet this should be so managed that the *ensemble* shall appear consistent, and the whole design all of a piece as to taste. Look at the Post Office—there are Ionic columns, but the structure itself is absolutely dowdy in its style. Look at the Post Office, Dublin—there we have another large Grecian Ionic portico attached to a very plain and ordinary house-front. Look at Goldsmith's Hall—the lower half of the design is altogether different and distinct in character from the upper one. Look again at Lord Sefton's new mansion in Belgrave Square—within a carriage porch of the very plainest Italian Doric possible, is a doorway of unusually rich design, which, in such situation, looks as much overdressed in itself, as it causes the columns and their entablature to look plain, even to the appearance of being unfinished. In a new house near Park Lane, I observe there is some approach to the Italian style, the elevation being crowned by a cornice somewhat bolder and richer than usual; but the windows!—they are in the modern Pseudo-Grecian fashion, with no other dressings than architraves, and those of the very plainest description. In all such cases it looks as if the architect had been obliged to pare down his design in order to save expense, and that, instead of simplifying it consistently throughout, he had merely omitted in execution that decoration which was in the first instance proposed as essential to unity of expression.

V. Another great and pervading vice in modern design is that so little regard is had to the sound and legitimate principle of commencing decoration by first applying it to essential features—those arising out of construction, or required by utility and convenience, instead of introducing what is merely for embellishment, while other things that cannot possibly be omitted or got rid of, are left not only plain, but quite rude in appearance, so as to become, by contrast, positive eyesores. That such errors in taste—such violation of all artistic principles of composition, should ever be committed, is grievous enough, but that it should be committed so very frequently, and by those who are so fastidious and puritanically pedantic in regard to matters of infinitely less importance, is most grievous and most provoking. Utility and beauty ought to go hand in hand, but should be made to do so after a very different fashion from what is now generally the case, when one half of a design aims at nothing more than unadorned usefulness, and the other at ostentatious show. Their usefulness does not reconcile us to ugly chimneys and chimney-pots confusedly huddled together on the roof of a building—to bare openings for windows, or else having only some scanty common-place mouldings bestowed on them,—to insignificance and vulgarity as regards matters of that kind, while unnecessary and inconsistent, therefore absurd parade is indulged in as regards others. One ill consequence of such unfortunate system is that people are satisfied with mere shreds and patches of design, and think it quite enough if they are able to say such or such a part is very good, though the general effect may nevertheless be poor in the extreme, and the whole no better than a jumble of the most incoherent and contradictory members.

Progress of Steam.—We learn that in a short time the merchants of St Petersburgh will have a direct line of steam communication, *via* the North of Germany, Yarmouth, and this city, with New York.—*Bristol Standard.*

ARCHITECTURE AS A FINE ART: ITS STATE AND PROSPECTS IN ENGLAND.

BY GEORGE GODWIN, JUN., F.R.S.

> "That art where most magnificent appears
> The little builder, man."

"I shall not neede (like the most part of writers) to celebrate the subject which I deliver. In that point I am at ease. For architecture can want no commendation, where there are noble men and noble mindes." So wrote Sir Henry Wotton more than two hundred years ago, with reference merely to the Roman style, when classic architecture was but beginning to revive:—before Inigo Jones and Sir Christopher Wren had nationalized it amongst us, or Lord Burlington's example and endeavours, had made a smattering of its principles almost a necessity of fashion. Since then, the treasures of Greece have been ransacked and sent home to us to correct our taste and aid the study; the claims of middle-age architecture to be regarded as the work of supreme genius have been admitted universally, (its intrinsic beauty, the extraordinary skill displayed in its development, its power of inducing

> "A stir of mind too natural to deceive;
> Giving the memory help when she would weave
> A crown for Hope!"

have all been felt,) and delineations of its choicest specimens in a thousand and one books have been dispersed amongst us to render its details more known, and its imitation less difficult.

The history of architecture has been written,—the beautiful relationship of the various styles has been shown, (each growing out of and in its turn producing,—) forming a narrative most interesting and striking to all who look not carelessly on the progress of the human family, and sufficient it might be thought, to arrest and retain the attention of all readers. The history of our ancient buildings is more fully felt to be inseparably connected with the history of our country,—every old stone in England is known to tell a story, and therefore should have now a firmer hold upon the people than then, and yet we doubt whether any might venture to repeat at this time Sir Henry Wotton's remark which we have quoted. Certain it is that many "noble men" care nothing about architecture, and that many more "noble mindes" seem to require it should have very much "commendation" before they will be induced to give attention to it.

The degree of ignorance on the subject of architecture to be found amongst persons in other respects not merely well informed, but even learned, is quite extraordinary. Grecian, Roman, Gothic, Elizabethan, as applied to architectural style, are to them but words without any corresponding ideas; they have never considered that architecture has a chronology, still less, a philosophy,—architectural integrity, harmony, proportion, fitness, are to them foreign things,—in fact, beyond a notion that architecture means piling one stone upon another, and forming places to live or meet in, they know nothing and care less.

Great part of this inattention on the part of the multitude to the interesting and noble study under notice, (and of which the results whether for good or ill, usually endure long, and are constantly before the eyes of all,) has been justly ascribed to the connection which exists in the public mind between architecture as a constructive *science*, and architecture as a *fine-art*, and every endeavour ought therefore to be made to enforce a knowledge of this difference on general readers, and to point out to them how large a source of fresh delight would be opened to them by its study in the latter point of view. The pleasure of travel is trebled by it. Proofs in aid of former studies, objects for investigation, incentives to inquiry, arise on all sides; tongues are literally, found in stones, and a habit is acquired of weighing causes, and testing by judgment whatever is brought before the mind, which is of the greatest value, not merely in this particular case but in all the affairs of life.

For the sake of example, but briefly, let a man possessed of its history, and imbued in some degree with its principles, visit, in company with one entirely ignorant of both, an old town, or be set down before a new building. In the first, he might perhaps find a massive piece of walling, formed of beach-stones imbedded solidly with mortar, and bound together at certain distances in its height, by layers of long thin bricks almost resembling tiles. This he would at once recognise as a remnant of the work of that period when the Romans brought, though as conquerors, the arts to England, and laid the foundation for after-elevation and prosperity. Britain and its skin-clad inhabitants, the invasion of Cæsar, the downfall of Rome, the invitation to the Saxons would be the concomitant remembrances.

One of the gateways leading into the cathedral-close—which we will suppose the town to possess, might present semi-circular arches springing from small columns, and ornamented on the face with a rude zig-zag moulding, or a series of bird's beaks, which he would know to be the design of some of those Norman architects who, after the conquest of England by Duke William, employed themselves actively for some time, in covering the land with donjons and churches. The abasement of the Saxons, the curfew, forest laws, the feudal system generally, would pass involuntarily through his mind, and afford matter for long and pleasant reflection.

The cathedral itself would perhaps display in part, the feathery lightness of the pointed style of architecture with lofty arches, pinnacles and buttresses, intermixed with work of later date, shewing arches almost flat, superfluity of adornment, and the decay of taste: all which would be sufficient not merely to recall to the initiated beholder the changes which took place in architecture during two or three hundred years, and ended in the importation of a style from Italy, in the reign of Charles I, or a little earlier, and a contemptuous disregard of the beautiful structures before spoken of, and then first termed *Gothic*, in derision,—but would bring before him the progress of Christianity, the power attained by the clergy, and the state of the country and the people, in a variety of fresh phases.

At the new structure again, he would perhaps see the clever adaptation of means to an end, and proportions well preserved; read in its architectural expression an accordance or otherwise, as the case might be, with its purpose; and study the causes which conduced to render the effect of the whole on the mind satisfactory and pleasing. Thus would the imagination of the one be gratified, his judgment strengthened, his sagacity increased, while the second, who had given no thought to the subject, and had gained no information upon it, would necessarily be blind to it all, or seeing, would understand not.

The analysis of the causes of beauty in works of architecture, is certainly far from an easy task; it yet remains for some powerful mind keenly perceptive and nicely discriminating to deduce a code of laws or principles to be universally applicable in this inquiry. Whether however, this is likely soon to be effected, or that these subtle properties will continue to evade reduction to general rules, it is difficult to say. At present we must be contented to apply in individual cases, a number of unconnected canons, and to investigate the particular results of certain arrangements of form, compliance with prejudices, or the production of novelty.

"The art which we profess," says Sir Joshua Reynolds, speaking of painting, "has beauty for its object; this it is our business to discover and to express; the beauty of which we are in quest is general and intellectual; it is an idea that subsists only in the mind; the sight never beheld it, nor has the hand expressed it; it is an idea residing in the breast of the artist, which he is always labouring to impart, and which he dies at last without imparting—but which he is yet so far able to communicate, as to raise the thoughts and extend the views of the spectator; and which by a succession of art, may be so far diffused that its effects may extend themselves imperceptibly into public benefits, and be among the means of bestowing on whole nations refinement of taste." Now in architecture, which is not an imitative art, but one of imagination and adaptation, if we may so speak, (born of necessity,) there are two other objects to be attained, namely, commodiousness, (or fitness for the purpose,) and stability: in reference to both of which, although perhaps it is not for these it is entitled to the appellation of a fine art, the claims of a building to perfect admiration must be tried. It seems clear that these qualities may exist without the production of beauty, even with *proportion* of the parts superadded,—(a word by the way the meaning of which is any thing but precise, as what is deemed proportion under some circumstances, or in one place, is not so in others;) but the production of beauty which will satisfy the mind can hardly be hoped for without minute attention to all these points. Variety and intricacy, with yet a prevailing uniformity, may be regarded as important in the production of pleasure in the spectator:—in so far as while the mind is able at once to comprehend and dwell upon the unity of the whole, it may be interested in the novelty or propriety of each detail, and find delight in this indication of the energy, ingenuity, and power displayed in its formation. We must not however here venture on an inquiry, which interesting as it may be, is beyond the intention of the present paper.

To return, then, to our former subject. The neglect which architecture has experienced at our universities (as, indeed, have all the arts), is another plainly apparent cause of the ignorance complained of, and it is gratifying to see indications, although but partial, of the presence of a different spirit amongst the members of the universities, if not in the universities themselves. Oxford and Cambridge both have now societies for the study of Gothic architecture, and for the purpose of aiding in the proper restoration of old buildings. Many papers of great merit have been read at both, and museums of casts

have been commenced, classified in such a manner as to aid materially in impressing on those who will study them, the peculiarities and characteristics of the various æras in architectural history. In Bristol a similar society has been formed recently, and it is to be hoped that the example will be extensively followed throughout England.

Among the important advantages, not before alluded to, as certain to arise from the spread of architectural knowledge, would be an almost immediate improvement in the professors of the art themselves. Improve the capacity of the judges, raise the ordinary standard of taste, create a demand for superior skill, and the result inevitably must be that individuals will be found capable of supplying it, and that fine works will be produced.

The association of architects not merely for the study of their profession and the interchange of opinions and kindly feelings, but with a view to popularize their art, and by spreading abroad their Transactions, and inviting strangers to their meetings and *conversazioni* to render it matter of general interest, must be regarded as likely to assist greatly in removing the ignorance complained of. The Royal Institute of British Architects, a chartered body, including in its list of members the greater number of the heads of the profession, in correspondence with most of the continental states, and presided over by one of the most accomplished noblemen of the day, may be considered as the chief of these associations, and has it in its power to influence the age very materially—more so indeed than it has yet attempted to do. The publication of a volume of its transactions, at least annually, should be regarded by the members as most important, while, to make these transactions valuable and effective, should be the constant study of all who are connected with the Institute, or wish well to their art.* The London Architectural Society, the Institute of Irish Architects, and the Manchester Architectural Society, are all influential bodies of a like character, and are called on to exert efficiently the power which is in their hands.

At the Royal Academy, where of late years an inexcusable degree of inattention to architecture has been manifested, affairs are wearing a more promising aspect. The present accomplished professor, Mr. Cockerell, has entered on his duties with singular and praiseworthy zeal, and eminent as he is for a love of his art and desire to spread a knowledge of it, will not fail to pursue them energetically in a right course. The establishment of schools of design throughout the country (in the arrangement of which Mr. Cockerell has taken active part, as also did Mr. J. B. Papworth,) will be of great service to architecture, by increasing the number of those able to carry out effectively the designs of architects, while, by imbuing artizans with an artistical feeling, they will serve materially to raise their callings in the scale of society. How greatly the architects of the middle ages were indebted to the ability and feeling of their operatives is too well known to need notice here.

The want of information, and the low state of architectural taste, which have been complained of as still existing, have been strikingly exemplified in the results of many competitions for designs which have been brought before the public within the last ten years. The insufficient particulars and instructions given to architects, the want of courtesy displayed towards them, and the ultimate unjust decisions, have proceeded in as many cases from entire ignorance, with a wish to act rightly, as they have from underhand influences and bad motives. And until we can in some degree remove these first-mentioned evils, we can hardly hope, however much we may strive, to prevent this injurious result, injurious not less to the public than to the artists and art itself. That artistical competitions, by affording opportunities for the encouragement of unaided merit, by preventing professors of established practice from falling into a routine habit of composition, and by inducing young men to study subjects which otherwise might not come under their notice—are advantageous, is the opinion of the great majority of those who have thought upon the matter. We would go so far as to say that for *all* works entitled by their destination or importance to be called national, the nation should unquestionably be appealed to, and opportunity thus given for unknown talent to come forward.

Brunelleschi, Michael Angelo, Palladio, Fontana, Scamozzi, are all to be found in the list of those who competed for the honour of conducting important works in Italy. In England, however, until the decision in these matters can be more depended on than now, (when, in fact, the administration of every succeeding competition is worse than that which preceded it,) men of integrity and ability who have reputation to lose, will not enter the lists except in special cases, and the result must be that the field will be left chiefly to unemployed tyros or manœuvring traders.

If we be correct in our opinion, that until information be spread and the taste of the multitude be improved, we cannot expect to effect much alteration, it is to this end surely we should apply all our efforts, vigorously and unceasingly. Why should not architecture and the other fine arts be taught universally in our schools, and be made a necessary part of a liberal education? At all events, professorships should unquestionably be instituted at the universities, to spread a knowledge of the beautiful, and inculcate a love for it. Every day is science exerting its powerful influence to liberate men from the necessity of manual labour. Every day, therefore, does it become more and more necessary that unemployed minds should be put in the right track, that intellectual and moral wants should be created, and that all means be taken to elevate the taste of the multitude, and supply their cravings for excitement with proper *pabulum*.

To improve a love of the fine arts amongst a people, not irrespective of RELIGION, but in connexion with it, must be regarded by all wise and enlightened statesmen as an object of paramount importance, to be attained almost at any price.

* If a monthly *bulletin* were issued in a cheap form, containing an abstract of each night's proceedings, it would be of much service. Unconnected items of information elicited in conversation, and papers not sufficiently important to appear in the "Transactions," might therein be recorded. Information would thus be spread, and there would be an additional motive for members to communicate matters which, though trifling in themselves, might be important in the aggregate. Besides, the more the fine arts are talked about and written about—the oftener they are brought under public notice, the more likely it is they will receive general attention. The public require a thing to be said a great number of times, and in a great many ways, before they will hear it.

ENGINEERING WORKS OF THE ANCIENTS, No. 9.

IN our present paper we conclude our extracts from Strabo.

THE GREEKS.

The silver mines of Attica (Book 9, chap. 1), were formerly very productive, they are now exhausted. When they still produced a slight return for the labour of the miners, they melted up the old rubbish and scoriæ, and a considerable quantity of very pure silver was obtained from them, seeing that the ancients were not very skilful in the art of extracting metal. A commentator remarks on this passage that it is a proof of the progress of mining in this age, but that even then the Romans had been by no means gone to the extent of modern art, as sufficient is still sometimes found in Romish scoriæ to pay for the expense of extraction. He farther observes that the mines of Laurium showed signs of exhaustion in the time of Socrates (Xenophon Memorabilia, book 3, chap. 6, § 12.)

In the next page Strabo notices a bridge over the Cephissus.

In book 9, chap. 2, our author gives a description of the works on the Euripus, but one which is very inaccurate.

Speaking of the plains of Beotia opposite to Eubea (book 9, chap. 2), an account is given of the works undertaken to drain them by a contractor for works of the name of Crates of Chalcis. He was obstructed by the factions among the Beotians, but in a report, addressed by him to Alexander, he relates that he had already drained several large tracts. This contractor is also mentioned by Diogenes Laertius, book 4, § 23, as being employed by Alexander.

In book 10, chap. 1, is an obscure passage relative to the mines of Chalcis.

In the same, chap. 3, Strabo refers to the labours of Hercules on the Achelous.

The Rhodians as well as the Cyzicans and Marseillese were famous as military engineers (book 14, chap. 2.)

CILICIA.

Book 12, chap. 1, contains an account of the mode in which King Ariarathes the 10th stopped up the Melas, a feeder of the Euphrates, and how the dike having burst and caused injury to the neighbouring lands, the king was fined 300 talents by the Romans.

PONTUS.

Chapter 2nd of the same book describes the mode of working the mines of Sandaracurgium.

EPHESUS.

The entrance of the port of Ephesus is too narrow, the fault of the architects and engineers, who were led into error by the king, who employed them on this work. This prince, who was Attalus 2nd, Philadelphus, King of Pergamus, seeing that the port was being silted up with banks from the deposits of the Cayster, and thinking that it could be made deep enough to receive large vessels, if a mole were thrown before the entrance which was too broad, ordered the con-

struction of the mole. The contrary however happened, for the mud filled the port with shoals as far as the entrance, whereas before the deposit was sufficiently carried out by inundations, and by the reciprocal movement of the waters of the outer sea. Such are the defects of the port of Ephesus (book 14, chap. 1).

PERSIA, &c.

Alexander in his expedition to Gedrosia was preceded by miners to search for water (book 15, chap. 1).

In book 15, chap. 3, a bridge is mentioned as being thrown over the Choaspes at Susa.

In the next page sluices are mentioned on the Tigris.

In book 16, chap. 1, an enumeration is made of the works of Semiramis.

Alexander destroyed a number of sluices on the river Tigris. He also occupied himself with the canals, which are of the greatest importance to the agriculture of that country (B. 16, ch. 1), a theme upon which our author dwells at some length. He relates, on the authority of Aristobulus (see also Arrian, B. 7, § 22), that Alexander, seated in a boat steered by himself, attentively surveyed the canals, and caused them to be cleaned by employing a great multitude of men, whom he took with him. He also had certain outlets closed and new ones opened. He remarked a canal, principally leading to the lakes and marshes on the Arabian side, and the outlet of which, on account of the softness of the ground, could not easily be closed; he therefore opened a new canal or mouth about 30 stades off, in a rocky ground, through which he turned the waters.

EGYPT.

In his 17th Book, Strabo describes Egypt. He mentions the skill the Egyptians showed in hydraulic works, but the fact upon which he dwells is partly perhaps attributable to Roman science. He says that before the time of C. Petronius (ch. 1) Governor, A. D. 20, that the greatest inundation and most abundant harvest took place when the Nile reached fourteen cubits, but that under the administration of that governor an inundation of twelve cubits produced abundance.

In that book and chapter there is frequent mention of canals, and there is a description of the canal of the Red Sea. (See also Diodorus Siculus, B. 1, § 19 and 33.

Here also Strabo describes the Egyptian mortar as being made of pounded basalt, brought from the mountains of Ethiopia.

PAUSANIAS—ÆLIAN AND APPIAN.

In Pausanias the only notices in any way relating to our subject are an allusion to the silver mines of Laurium in the commencement of the Attics, and in the Laconics a statement that Eurotas diverted the river. In Ælian and Appian there is nothing except perhaps that the latter, in the account of the siege of Carthage, mentions a cut made through the harbour by the Carthaginians.

ARRIAN.

Arrian in his Life of Alexander, 7th book, chap. 21st, gives a better account than Strabo of Alexander's repair of the canal called Pallacopas, although this latter account differs, we shall content ourselves with a reference to it. We may observe that Gronovius has annexed to his edition of Arrian a small treatise on this canal, which embodies all the account and modern information respecting it.

In his second book Arrian devotes much space to the siege of Tyre, from which we shall extract some of his remarks on the mole. He says that the sea there has a clay bottom, and shallow towards the shore; but when you draw near the city, it is almost three fathoms deep. As there was abundance of stone not far off, and a sufficient quantity of timber and rubbish to fill up the vacant spaces, they found no great difficulty in laying the foundations of their own rampart; the stiff clay at the bottom, by its own nature, serving instead of mortar, to bind the stones together. The Macedonians showed a wonderful forwardness and alacrity to the work, and Alexander's presence contributed not a little thereto; for he designed every thing himself, and saw every thing done. In describing the subsequent operations Arrian says that many engineers, meaning military engineers, were brought from Cyprus and Phenicia.

In the fifth book a long account is given of the mode adopted by the Romans, and particularly by the old Romans, in forming temporary bridges for crossing large rivers.

The British Queen Steam-ship.—This splendid steamer sailed yesterday for Antwerp. A select party of gentlemen went in her on a visit to Belgium. The British and American Steam Company have, it is said, received for her the sum of £60,000 from the Belgian government. For the President the same company received above £70,000 from the underwriters. The losses sustained by the company since its establishment are supposed not to be less than £80,000 nor more than £100,000.—*Liverpool Albion, Sep. 6.*

ON THE MANUFACTURE OF BRICKS AND TILES.

[We are indebted for the following article to a very useful work by Mr. Aikin, just published; we have appended some additional notes, which we think will be found useful, and make the article more complete.—EDITOR.]

Till lately, bricks appear to have been made in this country in a very rude manner. The clay was dug in the autumn, and exposed to the winter frosts to mellow; it was then mixed, or not, with coal ashes, and tempered by being trodden by horses or men, and was afterwards moulded, without it being considered necessary to take out the stones. The bricks were burnt in kilns or in clamps; the former was the original mode, the latter having been resorted to from motives of economy. When clamps began to be employed I do not know; but they are mentioned in an act of parliament passed in 1726, and therefore were in use prior to that date. The following, in few words, is the present process of brick-making in the vicinity of London, for the practical particulars of which I am indebted to Mr. Deville and Mr. Gibbs.

It is chiefly, I believe entirely, from the alluvial deposits above the London clay, that bricks are made in the vicinity of the metropolis; and a section of these deposits generally presents the following series, such as would naturally result from a mixture of stones, and sand, and clay, and chalk, brought together by the force of water, and then allowed to subside. The lower part of the bed is gravel, mixed more or less with coarse sandy clay and pieces of chalk; this by degrees passes into what is technically called malm, which is a mixture of sand, comminuted chalk, and clay; and this graduates into the upper earth or strong clay, in which the clay is the prevailing or characterizing ingredient, the proportion of chalk being so small that the earth makes no sensible effervescence with acids. Bricks made of the upper earth, without any addition, are apt to crack in drying, and in burning they are very liable to warp, as well as to contract considerably in all their dimensions; on this account they cannot be used for the exterior of walls; and a greater number of such are required for any given quantity of work than of bricks, which, though made in the same mould, shrink less in the baking. The texture, however, of such bricks is compact, which makes them strong and durable. Bricks formed of this clay, whether mixed or unmixed, are called stocks; it was formerly used unwashed, and when the bricks were intended to be kiln-burnt, or *flame-burnt*, to use the technical word, no addition was made to the clay. If they were intended to be clamp-burnt, coal-ash was mixed during the tempering. Of these and all other clamp-burnt bricks the builders distinguish two kinds, namely, the well-burnt ones from the interior, and the half-burnt ones, or place bricks, from the outside of the kiln.

The calcareous clay or malm earth requires no addition of sand or chalk, but only of ashes. The bricks made of it differ from those made of the top earth, in being of a pale or liver brown colour, mixed more or less with yellow, which is an indication of magnesia. The hardest of the malm bricks are of a pale brown colour, and are known by the name of gray stocks; those next in hardness are called seconds, and are employed for fronts of the better kind of houses; the yellowest and softest are called cutters, from the facility with which they can be cut or rubbed down, and are used chiefly for turning the arches of windows. What I have said of top earth and malm earth must be understood, however, to refer to well-characterized samples of these varieties, but, as might be expected, there are several brick-fields that yield a material partaking more or less of the qualities of both, and therefore requiring corresponding modifications in its manufacture.

Brick earth is usually begun to be dug in September, and is heaped rough, to the height of from four to six feet, on a surface prepared to receive it, that it may have the benefit of the frost in mellowing it and breaking it down. It is then washed by grinding it in water and passing it through a grating, the bars of which are close enough to separate even small stones. The mud runs into shallow pits, and is here mixed with chalk ground with water to the consistence of cream, if any calcareous ingredient is required. When it has become tolerably stiff by drying, coal ashes (separated by sifting from the cinders and small pieces of coal) are added, in the proportion of from one to two and a half inches in depth of this latter to three feet of clay, the most tenacious clay requiring the greatest quantity of ashes. The ingredients are then to be well mixed; and, finally, the composition is to be passed through the pug-mill,* in order to complete the mixture

* The pug-mill is an iron cylinder set upright, in the axis of which an arbor or shaft revolves, having several knives, with their edges somewhat depressed, projecting from it and arranged in a spiral manner round the arbor. By the revolution of the arbor the clay is brought within the action of

and to temper it. The moulder stands at a table, and the tempered clay is brought to him in lumps of about 7 or 8 lb.: the mould is a box without top or bottom, 9⅜ inches long, 4⅜ wide, and 2⅜ deep;† it lies on a table: a little sand is first sprinkled in, and then the lump of clay is forcibly dashed into the mould, the workman at the same time rapidly working it by his fingers, so as to make it completely close up to the corners; next he scrapes off with a wetted stick *(strike)* the superfluous clay, throws sand on the top, and shakes the brick dexterously out of the mould on to a flat piece of board, *(a pallet board)* on which it is carried to a place called the hacks formed of the new bricks, into open hollow walls, which (in wet weather) are covered with straw to keep off the rain; here they dry gradually, and harden till they are fit to be burnt. A raw brick weighs between 6 and 7 lb.; when ready for the clamp it has lost about 1 lb. of water by evaporation.* A first-rate moulder has been known to deliver from 10,000 to 11,000 bricks in the course of a long summer's day, but the average produce is not much more than half this number (1).

The price of bricks varies from forty to sixty shillings a thousand, of which not more than one shilling and three pence a thousand, at the utmost, can be the cost of moulding, assuming the average work of a moulder to be five thousand in a day; any improvement, therefore, calculated to save time in this department of brick-making by the introduction of machinery worked by steam, or by horse power, can only amount to a benefit equal to a fraction of one thirty-second or one forty-eighth of the entire price of the commodity. If we assume such machine to produce fifty-two million bricks in a year, this amounts to two millions a week (for the season for brick-making in this country continues no longer than from April to September inclusive) or three hundred and thirty thousand in a day, equal to the labour of sixty-six men or eleven horses, without making any allowance for friction, or any deduction on account of temporary repairs. The cost of hand-moulding fifty-two million bricks at one shilling and three pence per thousand is 3250*l.* from which, if we deduct the first cost and repair of machinery, the expense of fuel or of horses, of superintendence, &c. it would probably be found that nothing would remain for profit.

Bricks are burnt either in kilns or in clamps (2). In the former the burning is completed in twenty-four hours; in the latter it requires from twenty to thirty days, but is on the whole cheaper, notwithstanding that the loss from over-burning, from under-burning and other accidents amounts to one-tenth of the whole number of bricks (3).

The consumption of London is for the most part supplied from the brick-fields that surround it in all directions, the principal of which, however, are situated north of the Thames, at Stepney, Hackney, Tottenham, Enfield, Islington, Kingsland, Hammersmith, Cowley, Acton, and Brentford. Those made at Grays Thurrock, Purfleet, and

---

the knives, by which it is cut and kneaded, and finally is forced through a hole in the bottom of the cylinder.

* A malm brick of the above dimensions will shrink by burning to the length of 9 or 9¼ inches. A brick made of top clay without any mixture of chalk, will often shrink to 8½ inches.

† From some experiments made in France we learn the following particulars:—A mould 8 inches 3 lines long, 4 inches, 3 lines broad, and 2 inches 2 lines thick, yielded bricks which on an average weighed, when first made, 5 lb. 14 oz. When dried and ready for the kiln they weighed 4 lb. 8 oz. having 22 oz. of water; 9 oz of this quantity evaporates in the first twenty-four hours, the other 13 oz. require five or six weeks to evaporate. By burning, 4 oz. more of volatile matter is driven off; a well-burnt brick of the above dimensions weighing 4 lb. 4 oz. A fresh-burnt brick when laid in water absorbs about 9 oz. *i. e.* from one-seventh to one-eighth of its weight.

It appears, however, from experiments by M. Gallon, that the weight of bricks varies according to the care with which the clay is worked or tempered. Some clay was well worked, and then beaten for half an hour, on the morning of the next day it was again worked and beaten as before, and in the afternoon was again beaten for a quarter of an hour, and was then made into bricks. Another parcel of bricks was made of some of the same clay, treated in the usual manner. Both parcels were dried in the air for thirteen days, when it was found that those made by the former process weigh d on an average 5 lb. 11 oz. each, while those made by the latter weighed 5 lb. 7 oz. Both kinds were burnt together for ten days; they underwent no relative change in bulk, but the weight of the former was 5 lb. 6 oz. and of the latter 5 lb. 2 oz.—*Arts et Metiers*, vol. iv.

(1) The operation of making the bricks is generally undertaken by one man called the moulder, who with his wife, children, and one or two men, form a gang. One of the gang, a man, wheels the soil to the pug-mill; after it is tempered it is removed by a boy or girl from the pug-mill to the *banker*, (the moulder's work-bench), it is then kneaded by a woman, who passes it to the moulder next to her, and as fast as the moulder turns the bricks out of the mould, they are removed by a boy on to the off-bearing barrow, which is wheeled to the drying-ground by 1 or 2 men, who set up the bricks in the hacks in a slanting direction, two in width, and about two inches apart, and 3 feet high; these hacks run the whole length of the drying ground and are placed in parallel lines 4 to 5 ft, apart. When the bricks have stood a few days, they are reset with a greater space between them, which operation is called *scintling*, and in about a week after, they are removed to the clamp or kiln.—Ed. C. E. & A. Jour.

(2) A clamp is formed first by raising the earth a few inches above the natural surface of the ground to an uniform level; some of the hardest of the new made bricks, or, if there be any in the field, some old bricks previously burnt are set on edge over the whole site of the intended clamp, which are to prevent the moisture of the ground penetrating the new made bricks. Flues are then formed by the bricks being laid side by side, with a small space between to the height of 3 feet and about 9 inches wide; the top is covered by bricks being set off on each side, until they form an arch or covering, these flues run the whole length of the clamp, and generally about 6 feet apart; they are filled with furze or dry faggot wood, over which are laid small sea coal, or breeze (cinders), the intermediate spaces are filled in with bricks (this operation is termed *crowding*) laid a short distance apart, and between each course a layer of breeze is laid and repeated the whole height. The upper courses are laid a little closer than the lower ones, as they receive a greater proportion of heat, the outside of the clamp is generally closed in with place bricks (half burnt or soft bricks), and the top covered with breeze and sometimes earth; when the clamp is made up the fuel in the flues is ignited, which communicates with the breeze laid between each course, and shortly the whole of the clamp is in a state of combustion, and becomes one mass of fire, communicating with the ashes contained in the bricks; part of the exterior is sometimes coated with clay to prevent the cold winds penetrating. As soon as the whole of the clamp is properly ignited, the flues are closed, when particular attention is required to prevent the fuel burning too fiercely or too slowly. If it burn or draw too quickly on either side, screens are placed on the outside to check the draught. When the whole is properly burnt, which is in about 25 or 30 days, the clamp is partially opened and allowed to cool; the bricks are then sorted, those which are properly burned are called *stocks*—if they are not sufficiently burned they are of a pale red colour and soft, called *place bricks*—if the fire has acted too fiercely, several of the bricks will be vitrified into one solid mass, which are called *burs*. The whole operation of making bricks from the time the earth is turned into the pug-mill to the time the clamp is open, averages about 6 weeks.

The kiln is of an oblong form, brick built, with one opening in the end or side, and generally 13 feet long, 10 ft. 6 in. wide, and 12 feet high; and will contain about 20,000 bricks, the walls, on the top, are about two bricks thick, and at the bottom three bricks; they are built battering (inclining) inwards, the bottom is covered with narrow recesses arched over with openings left in the top, having the appearance of lattice work, in these recesses is deposited the fuel, on the top the bricks are laid with spaces between to allow the fire to pass up; the upper courses are laid a little closer than the lower ones, and the surface covered over with old brick or tile rubbish to keep in the heat and prevent the rain damaging the upper bricks; when the kiln is full, s me wood is put in and ignited, to dry them thoroughly; when this is done, which is known by the smoke becoming transparent, the mouth of the kiln is closed with old bricks and covered with clay, leaving sufficient space for faggot; brushwood, furze, bavins or dry faggot wood to be put in and lighted. The fire being made up it is continued till the ashes assume a whitish appearance, and the flames appear through the top of the kiln, the fire is then slackened and the kiln cools by degrees. The process is continued, alternately heating and slackening till the bricks are thoroughly burned, which is generally in the space of 48 hours. The advantages of kiln burning is the greater certainty in the operation and shortness of time in burning, which is done in about two days, whilst the operation of clamp burning occupies frequently 30 days. The bricks are generally of a bright and sometimes dark red colour.—Editor C. E. and A. Journal.

(3.) The following are the prices for the several operations in brick making:—

DIGGING PER CUBIC YARD.	*s.*	*d.*
To digging the uncallow, including wheeling not exceeding *one run* (a run is three 20 feet planks placed in a continuous line, lengthways)	0	4
Digging and wheeling brick earth	0	4
Turning and soiling (mixing sand or ashes with the brick earth	0	2½

MAKING, PER THOUSAND.		
Making the bricks, including the tempering of the clay, molding, and hacking (stacking)	4	0
Scintling (removing and restacking the bricks in the hacks)	0	2½
Crowding (placing) the bricks in the clamps or kiln	1	4½
Two yards of clay or brick earth (which will make one thousand bricks) digging and soiling at 6½*d.* per yard	1	1
Wear and tear of tools (found by the master) and keep of horse	2	0
One-fifth of a chaldron of ashes for soiling, at 5*s.* per chaldron	1	0
One-fifth ditto of breeze for fuel, 7*s.* 6*d.* ditto	1	6
Straw 6*d.*, sand 6*d.*	1	0
Kiln or clamp expenses for attending to open it, loading carts, &c.	1	0
Duty	5	10
Rent	2	0
£1	1	0

To the above must be added the expenses for removing the uncallow, risk, losses, interest on capital sunk, &c., and if washed the additional labour and cost of chalk, &c. Stock bricks average at this time about 30*s.* to 32*s.* per thousand, in the field, and place bricks 24*s.* The price for the latter is almost prime cost, consequently a greater profit must be allowed on the stocks to cover all losses, which in wet seasons are very serious. The duty is obliged to be paid on the quantity in the hack, notwithstanding any part or the whole may be damaged or destroyed by wet weather or in process of manufacture; for these risks government allow 10 per cent., reducing the duty to 5*s.* 3*d.* per thousand on the quantity made before burning.—Ed. C. E. & A. Jour.

Sittingbourne, are of a very good quality and a fine yellow colour; stone-coloured ones are made near Ipswich, and have been largely employed in the outside walls of some of the new churches of the metropolis. At Cheshunt, in Hertfordshire, is a bed of malm earth of the finest quality, no less than twenty-five feet in depth; from this are made the best small kiln-burnt bricks, called paviers. They are hard, absorb very little water, and are used for paving the floors of stables, wash-houses, &c. They have entirely superseded the use of Dutch clinkers, which formerly were imported from Holland in large quantities. The red sandy bricks called Windsors are made at Hedgerley. There is a considerable exportation of bricks from London; many being sent to the West Indies, to Quebec, and to other colonies.*

Tiles, from the purpose to which they are applied, namely, roofing houses in order to shoot off the rain, require a texture as compact as can be given to them, consistent with a due regard to economy. The fattest and most unctuous clays are, therefore, those which answer the best, especially if free from gravel and the coarsest sand. The price of tiles, compared with that of bricks, is such that the manufacturer can afford to dry them under cover; while, being not more than one quarter of the thickness of bricks, the drying is more speedily performed, and with far less hazard of warping or cracking: the same also is the case with the baking. Sand is added to the clay, but sparingly; for if, on the one hand, it prevents the ware from warping, yet, on the other hand, it increases the porosity, which is a fault especially to be avoided. The general manipulations of grinding the clay and tempering it are analogous to those already described for making bricks; but more pains are bestowed in getting it to the utmost degree of plasticity so as to allow of its being rolled, like dough, into cakes of a proper thickness, which are afterwards brought to the required shape by pressing them into a mould.

ON THE PERCUSSIVE ACTION OF STEAM.

Our correspondent C. S. in the last number of the Journal has taken an observation which we made in the first part of our article on this subject in the August number in a wrong light; nor should we have expected him to have attached so much importance to that observation after reading the rest of the article, from which he would have seen that, if we thought it unfair of Mr. Parkes to attribute all the advantage of percussive action to Cornish engines, and none to others, we also considered the amount of that advantage to be equal to nothing, which we think clearly demonstrated by our reasoning; so that we cannot exactly be of opinion that Mr. Parkes *favours* the Cornish engines, simply by considering that the percussive force of steam is only developed in them. The remark that this force should be developed in a greater degree in Locomotive engines does not necessarily imply that it should be developed favourably; for, by reason of the lead given to the slide valve in those engines, the steam is first let on to the back of the piston, and its percussive force would therefore tend, as our correspondent justly observes, "to impede the engine, if not stop it altogether."

The rest of our correspondent's remarks, since they have for object "to show that the Cornish single-acting engines are the only ones at present in which the percussive force of steam could act with any very great advantage, and that the locomotives are the very worst in which it could be used as a motive force," and thus suppose the fact of its advantageous action in the former to be already established beyond all question, cannot be regarded as an answer to our article above mentioned, but merely to the single remark already alluded to, and to which he has, as we have shown, attributed a meaning we never intended it to convey. It is difficult to assign a reason for his replying to the least important portion of our article, and passing over the main argument in silence.—Is it that he considers the question of the propriety of applying the principle of Percussion to the action of the steam as above discussion?—This was not very reasonable, since he has, so far as we are informed, the authority of but one writer, the infallibility of whose theories has not hitherto been established by experience; in proof of which, see the Count de Pambour's paper *On Momentum proposed by Mr. Josiah Parkes as a Measure of the Mechanical Effect of Locomotive engines*, and our Reviews of Mr. Parkes' paper on the same subject, in the Journal of last year, page 102. We must, however, assume this to have been our correspondent's motive for abstaining from any discussion of the principle of the percussive action of steam, as otherwise we should be reduced to the alternative of either supposing that he did not understand the reasoning by which we demonstrated, or attempted to demonstrate its fallacy, or that he followed Paddy's plan of beginning at the end. Be this as it may, the following remarks may perhaps induce C. S. to modify his opinions in some measure.

He observes that, "in a common double-acting rotative engine, where the steam is let into the cylinder when the crank is just passing the centre, it is evident that any percussive force of the steam striking upon the piston could not by any means have any effect in turning the crank." But he states farther on that "the action of this force is avoided in this case, as well as in that of the Locomotive engine, by the gradual motion of the slide, for as soon as the slide begins to open the steam way, the steam rushes into the cylinder, and strikes upon the piston, but with very little effect, on account of its being so much wire-drawn in consequence of the small size of the opening at first." It would naturally be inferred from this latter observation that our correspondent supposed the percussive action of the steam to be confined to the moment when the valve begins to open, in other words, that it is only *the first portion* of the steam which has any percussive action, and that this action is communicated instantaneously to the piston the moment that portion of steam passes through the valve; which, if it were true, would obviate the development of percussive action in Cornish single-acting engines as well as in those above mentioned; for the steam valve of a Cornish engine, though opened more suddenly than the slide valve, is nevertheless not opened instantaneously, but more or less gradually. If, on the other hand, we assume the development of this action to occupy some time, however brief, so as to allow of the opening of the valve of the Cornish engine, (which is equally necessary for the double-acting rotative engine), then must we also admit, not only that there is percussive action in the latter as well as in the former, but also that this action must assist in turning the crank, which will have passed the centre before it has ceased to operate.

We do not agree with C. S. in the opinion that "in order to render the percussive force of steam available to its fullest extent as a moving power in single-acting pumping engines, it would be necessary to have some medium interposed between the direct action of the steam on the piston and the pumps; so as to convert the ever-varying pressure on the piston into a regular and steady pressure on the plunger of the pump;" for the condition of a constant pressure on the pump bucket, is by no means indispensable, as the effect of a diminution of pressure on the steam piston, supposing such medium not to exist, would be simply a corresponding diminution of the velocity, or of the acceleration of the bucket and column of water, which would by no means affect the application of the percussive force of the steam. This column of water is, however, considered by C. S. as a medium interposed between the direct action of the steam on the piston and the pumps, which is curious enough, since the action of the steam works the pumps, and these raise the column of water.

We cannot make out that our correspondent's remarks have in any degree shown, as he supposes, "that in the Cornish engine we might use the percussive force of steam as a moving force to a very considerable extent;" for such negative evidence as that which he reproduces from Mr. Parkes' paper, viz. that the duty performed by those engines is greater than he could otherwise account for, cannot be admitted as rigorous. What is required of the supporters of Mr. Parkes' opinions is a *direct* proof that in Cornish or any other engines, the steam develops a power, by means of percussion, *in addition to* that measured by its elastic force, without which it is idle to enter into any discussion respecting the comparative fitness of different kinds of engine for the development of this additional power.

ON THE POWER OF THE SCREW.

We have received a letter from Mr. J. R. Cussen, in defence of the views set forth by him in a communication published in our Journal for May last, and which were partially refuted by a correspondent in the July number. We cannot insert this letter, since it is evident that the writer is in error on all points; but for his information, and the information of any other persons who may be led into error by his arguments, we shall point out clearly in what his mistakes consist, and how they have probably arisen.

As to his first objection to the theory laid down by the Rev. Mr. Bridges, our July correspondent alluded to above is undoubtedly right with regard to the meaning of *d*, which signifies the *height* of the inclined plane, or distance between the top of one coil of the thread of the screw and the top of the next, which is the distance through which the resistance is moved in one revolution of the screw,

* The whole number of bricks made in Great Britain and Ireland in the year 1835, on which the excise duty was paid, was 1380 millions.

and is called the *pitch* of the screw; it could not possibly signify, as understood by Mr. Cussen, the distance from the upper side of one coil of the thread to the under side of the next, as that would admit of an infinite number of different solutions to the problem of finding the power necessary to overcome a given resistance, according as the ratio of the thickness of the thread to the interval between its coils might be more or less, which circumstance could not effect the result, since it is only the upper side of the thread, or that which is in contact with the resistance, which sustains the resistance. Mr. Cussen may, therefore, rest satisfied that all theorists agree with him in substance, if not in expressions.

Respecting his second objection, Mr. Cussen has overlooked the chief part of the theory of the *lever*, and, unless he objects to that theory also as now taught by *all* authors and professors without exception, the following reasoning will convice him of his error.

We will take his examples of the three screws, each of ½ inch thread, which, converted into intelligible mechanical language, is one inch pitch, and of 3, 6, and 9 inches diameter respectively, worked by a lever of 90 inches long, the lever moved by a windlass of one ton power. But it is necessary first to understand clearly what is meant by a lever 90 inches long. In mechanical language its signification is the distance in a straight line from the fulcrum (which is in the axis of the screw) to the point of application of the power, which does not, however, seem to be the meaning attached to the expression in Mr. Cussen's second letter; he seems rather to mean the distance from the *surface of the cylinder* to the point of application of the power, which is not the true measure of the power of the lever; we shall therefore take the liberty of understanding it in the former sense. This being premised, suppose for a moment that no lever is used; we shall have, by Mr. Cussen's, as well as by Mr. Bridges' formula:

in the first case $1 : 3 \times 3{\cdot}1416 :: 1 : w = 9{\cdot}4248$ tons,
in the second case $1 : 6 \times 3{\cdot}1416 :: 1 : w = 18{\cdot}8496$ tons,
in the third case $1 : 9 \times 3{\cdot}1416 :: 1 : w = 28{\cdot}2744$ tons.

Now the power is applied in the first case at a distance of 1½ inch from the fulcrum, in the second at 3 inches, and in the third at 4½ in. distance; so that, by applying it at a distance of 90 inches in all three cases, we shall obtain the following results respectively:

in the first case $1\tfrac{1}{2} : 90 :: 9{\cdot}4248 : w = 565{\cdot}488$ tons,
in the second case $3 : 90 :: 18{\cdot}8496 : w = 565{\cdot}488$ tons,
in the third case $4\tfrac{1}{2} : 90 :: 28{\cdot}2744 : w = 565{\cdot}488$ tons,

or the pressure independent of the diameter of the screw, which overthrows the second objection.

Mr. Cussen's third objection falls to the ground with the preceding, indeed it has no meaning at all; for he *virtually* multiplies by the circumference of the circle described by the extremity of the lever when he multiplies by the circumference of the screw and by the length of the lever, although he omits to divide by the semidiameter of the screw, as he ought in that case to do, and as it will be seen, on an inspection of the above calculations, we have done to obtain the final value of w. If we take the first case, we had finally

$$w = \frac{1 \times 3 \times 3{\cdot}1416 \times 90}{1 \times 1\frac{1}{2}},$$

and it is obviously the same thing whether we suppose 3·1416 to be first multiplied by 3, to give the circumference of the screw, and the product to be afterwards multiplied by 90 the length of the lever, and divided by 1½ the semidiameter of the screw, as above, or whether we suppose 3·1416 to be first multiplied by *twice* 90, to give the circumference described by the extremity of the lever, and as the factor 3 of the numerator is essentially twice the factor 1½ of the denominator, these two factors disappear. Or, to make it still more apparent, let r represent the radius of the screw, d its pitch, l the length of the lever (measured from the axis of the screw), P the power and w the resistance. Then the last equation would be

$$w = \frac{\mathrm{P} \times 2\,r \times 3{\cdot}1416 \times l}{d \times r}$$

from which it is evident that, if we take the 2 from the factor $2\,r$, and multiply it by the two factors 3·1416 and l, we shall obtain the circumference described by the extremity of the lever, or by the power; and this product, multiplied by $\mathrm{P} \times r$ will obviously be the same as if the product $2\,r \times 3{\cdot}1416$, which is the circumference of the screw, were multiplied by $\mathrm{P} \times l$. But Mr. Cussen has committed the error of leaving out the factor r in the denominator, forgetting that when no lever is used, the power is applied at the circumference of the screw, and that the leverage is equal to r, so that when the leverage is increased to l, the resistance is increased in the ratio $\frac{l}{r}$. Having demonstrated Mr. Cussen's error, and shown its probable origin, we may now cancel the r in the numerator and denominator of the fraction, and it will remain

$$w = \frac{\mathrm{P} \times 2\,\pi\,l}{d},$$

π being the ratio of the circumference of a circle to its diameter.

If Mr. Cussen's remark "that one-third of the calculated power is lost by friction," is meant to bear upon the comparison of the effect of screws of different diameters but the same pitch, it will be found on investigation that the friction bears no fixed ratio to the resistance, but increases in a slightly greater ratio than the diameter of the screw, and thus gives a proportionate advantage to screws of small diameter.

ON THE ECONOMY OF FUEL IN LOCOMOTIVES CONSEQUENT TO EXPANSION AS PRODUCED BY THE COVER OF THE SLIDE VALVE.

Sir—Having observed several errors in Mr. J. G. Lawrie's calculations, published in your useful and interesting Journal for August last, allow me to point them out for the benefit of your readers.

I should premise that the formulæ he has given for the several distances travelled by the piston: from the commencement of the stroke to the commencement of expansion, from the commencement of the stroke to the opening of the eduction port (not to the end of expansion, for expansion continues, but more rapidly, and the effect during the rest of the stroke is not to be neglected), and from the commencement of the stroke to the position of the piston when the valve opens for the lead of the next stroke, are correct. I should however observe that the expressions under the radical sign in the values of a' and c' are identical, and may be reduced to $(1-c^2)\,[1-(l+c)^2]$; and perhaps it would be better if the expressions $(1-l\,c-c^2)$ and $(1+l\,c+c^2)$ in the same two values were written respectively

$$[1-c\,(l+c)\,] \text{ and } [1+c\,(l+c)\,].$$

The errors I have discovered are in the computation of the effect, which follow.

Mr. Lawrie finds the volume of steam of the initial pressure p admitted during the stroke to be equal to $s\left(a' - \frac{(2\,d-b)\,t}{p}\right)$, (at least I suppose this expression to have been meant by the writer, although the factor s is omitted and h is printed instead of p in the denominator,) which is a sufficiently near approximation, but I cannot comprehend how he can make this quantity equal to $2\,d \times 1$, although he observes with truth that the quantity of fresh steam must (whatever the expansion is) be constant; but a constant quantity is not necessarily an arbitrary one, as which it might be considered in this case, for we may give s any value we please, and it would follow that the quantity of steam used per stroke would be the same, whatever the area of the piston might be, provided the length of stroke, lead and cover of the slide were the same. And if we supposed the area of the piston $s = 1$ square foot (a reasonable hypothesis), the factor 1 in the expression $2\,d \times 1$ signifying (as I suppose) also 1 square foot, we should necessarily have $a' - \frac{(2\,d-b)\,t}{p} = 2\,d$, which is impossible, for $a' \angle 2\,d$. His expression of the value of s is therefore incorrect; besides it is obviously impossible to deduce the area of the piston from the length of stroke, cover and lead of the slide, and ratio of the greatest to the least pressure in the cylinder, without knowing how much steam is generated in the boiler.

Secondly, the effective working pressure during the expansion is found $= \frac{a'\,p}{x} - t$, x expressing the distance travelled by the piston from the beginning of the stroke; and this expression will give too great a value by 3 or 4 lb. per square inch, if not more; for t is used to express the least pressure of the steam in the cylinder, which it has at the moment when the eduction port is closed, and which probably scarcely exceeds the atmospheric pressure, and the mean resistance of the waste steam amounts to 4 or 5 lb. per square inch. Besides this, the formula given to express the quantity of work done during the portion b of the stroke makes no allowance for the diminution of temperature consequent on expansion; but this may be too slight to be of any consequence, as the expansion is inconsiderable in locomotives; nor is any allowance made for the waste space which has to be filled with steam. But the effect during the rest of the stroke is not to be

neglected, that is, from the moment when the eduction port is opened to the termination of the stroke; for, on account of the very small opening of the port during that period, very little steam is enabled to escape, and it had previously been but slightly reduced in pressure by expansion, so that its mean pressure during this last portion of the stroke will bear a considerable proportion to its initial pressure, and cannot therefore be neglected. On the other hand, the effect of the compression of the spent steam of the pressure t, between the instant of shutting the eduction valve and that of opening the steam valve, is so small that it might much rather be disregarded; for it commences with a pressure of about 1 atmosphere and terminates with about 1·4, say on an average ½ atmosphere through one-fortieth part of the stroke, or about one-tenth of a lb. through the stroke, due to compression.

Thirdly, Mr. Lawrie makes the inexplicable assumption that the safety valve be so loaded that $p = s$ — the initial pressure of the steam in atmospheres = the area of the piston!—Supposing the square foot to be the unit of area, and $s = 1$ square foot; we should then have $p = 1$ atmosphere, and the engine would not move; but if the square inch were the unit of area, for the piston of the same size as before we should have $s = 144$ square inches, and consequently $p = 144$ atmospheres!—These results show the manifest absurdity of the supposition.

Lastly, the values of a', b and c', in the examples which close the paper, are not determined correctly from the formulæ which, I said above, are themselves correct, so that the whole paper requires revision and correction, except the first part, as I have explained.

Hoping that the above remarks may be found serviceable to your readers,

I remain, &c.,

M.

MR. JOSIAH PARKES IN REPLY TO COUNT DE PAMBOUR.

MR. EDITOR—M. de Pambour has recently repeated, in several of the weekly and other periodicals, certain virulent strictures on my writings. I am at a loss to conjecture on what grounds that individual should have indulged in these, as well as in his earlier, and nearly similar, attacks upon me. I have, hitherto, declined replying to them, and for two reasons; first, I did not wish to convict a man of M. de Pambour's celebrity of deliberate misrepresentation; nor, secondly, to expose, more publicly than he had himself done to persons really conversant with the steam engine, his lamentable ignorance of practical matters. But, his resumption of these attacks, in the present form, renders it incumbent on me to be no longer silent. I, therefore, avail myself of the same medium of communication, and shall confine my reply to the exhibition of one instance of his gross ignorance, and of one instance of his numerous, and injurious, falsifications of my opinions and writings.

Every engineer is acquainted with the *cataract*, an instrument nearly as old as Newcomen's engine, and used for the purpose of opening the steam induction valve, and thus starting an engine, after any required period of rest. This species of water clock is also occasionally employed to open other of the valves at definite times. The Cornish engineers appreciate its value, not only as a means of regulating the number of strokes to be made by a pumping engine, in a given time, but also as effecting the influx of steam into the cylinder in the most instantaneous manner. Neither they, nor any other engineer ever, probably, imagined the cataract to exercise an influence over the *production of steam* in the boilers of their engines. The Comte de Pambour, however, ascribes to the instrument this miraculous virtue, in the following passage:

"We will finally remark that it is customary in these engines to make use of the *cataract*. Under this circumstance the engine does not evaporate the full quantity of water, that its boiler would otherwise be capable of evaporating per minute; but, on introducing into the formulæ the evaporation really effected, the formulæ will always give the corresponding effects of the engine."—*(New Theory of the Steam Engine. J. Weale, 1839, chap. xi., Cornish Single Pumping Engine, p. 278.)*

This *is*, verily a *new theory*. No observations of mine are requisite to illustrate the absurdity of theories, and formulæ, emanating from a person who is so little practically versed in the mechanism, and auxiliary apparatus of an engine, as to jumble together, and confound, in one paragraph, the distinct functions of the *cataract*, the *boiler*, and the *engine*.

In a later work, M. de Pambour has devoted no less than 16 pages of introductory matter to a criticism of my Paper on the Locomotive Engine, (published in the Transactions of the Institutution of Civil Engineers, vol. iii.), in which, among others, I had occasion to examine his own experiments. In that paper not a word will be found disrespectful of M. de Pambour; his sentiments are treated with courtesy; and, at the risk of being thought tedious, I prefaced each of my observations on his conclusions with a quotation of the matter commented upon. M. de Pambour's reply contains numerous misapprehensions of my meaning, and arguments, of which I do not complain; but every author has fair ground of complaint against the antagonist who perverts his text; who invents arguments for him; or who cites, as authentic quotations, phrases which he never employed. In no one instance has M. de Pambour quoted my own words; in lieu of which he has frequently invented words and opinions for me. The following extract affords a concise example of the veracity and style of the 16 pages of criticism.

"The want of using equations which facilitate so much accuracy in mathematical reasoning (*and the author accounts for it in telling us that he is more accustomed to handle his hammer than his pen,*) causes him to heap errors on errors, combining and complicating them unaware, till he arrives at a point where he does not produce a single result that is not erroneous."—*(A Practical Treatise on Locomotive Engines,* 2nd edition. J. Weale, 1840. *Introduction,* page xxxiii.)

The paragraph in italics is a pure invention. No such words even occur in my paper as *hammer* or *pen*.

The writer who resorts to the miserable tactics of falsifying the language and opinions of one who differs from him on subjects open to large controversy, exhibits a consciousness of inferiority in his arguments, which it would have been wiser, and far more manly to acknowledge, than to attempt to conceal, by expedients so unworthy, and so certain of detection. Such a man may, possibly, be a skilful mathematician, but he cannot claim rank among *philosophers*, whose sole objects are the discovery and propagation of *truth*. I consider myself exonerated from all obligation to reply, in greater detail, to an adversary who descends to such ignoble practices; but justice to my own reputation requires that I should expose them to public reprobation. This I do with the more regret as I have derived both instruction and pleasure from some parts of M. de Pambour's researches.

I remain, Sir, your obedient servant,

JOSIAH PARKES.

12, *Great College-street, Westminster,*
September 13, 1841.

LONG AND SHORT CONNECTING RODS.

SIR—In your September number there are two communications animadverting on my paper on connecting rods in the July number. In this paper, my object was to establish the soundness of the connecting rod, *in general*, as a medium of moving force, and thereby to endeavour the settling of the controversy about long and short rods. For it is not disputed by any, I presume, that the strains and consequent friction between moving parts, in machinery, occasioned by connecting rods on the same crank, are in a certain proportion to their lengths; and I agree that herein longer rods have the advantage of shorter. But the question has been, whether, purely as transmitters of force, the former has any superiority to the latter, which leads to the question whether generally and abstractly, connecting rod motion is just as a medium of force. As I have said, it was my object to prove the affirmative of the question. Therefore, in this view of the subject rods of different lengths to the same crank ought to be one in effect.

Though certainly I did not notice the fact, I was aware that the connecting rod would not work on a crank of the same length in the usual style. We may mention, however, that a modification of this case is in fact practised in epicycloidal motion, a demonstration of which is given in March number for last year, in which the stroke of the piston is twice the throw of the crank, and the radius of the inner wheel is the connecting rod.

I am, Sir, your's, obediently,

D. CLARK.

Glasgow, September 16, 1841.

Artesian Well at Grenelle.—M. Mulot, in some of his recent experiments at the Artesian well in the abattoir of Grenelle, succeeded in forcing the jet of water as high as 63 feet above the ground, and when it reached this height, the water assumed a bell shape, ten metres in diameter, which produced the most picturesque effect. Unfortunately the water continues muddy; therefore, though there is a certainty of being able to procure nearly 2000 litres of water in the course of a minute, at a height which admits of its being conveyed into the highest stories of the houses in Paris, it is not yet known to what purposes the water can possibly be applied.

EPISODES OF PLAN.

(Continued from page 290.)

The breaks and interruptions occasioned by our "Episodes" being given to the reader piecemeal in monthly portions, are attended with no injury to our essay, and with some convenience to ourselves, by in some measure concealing abruptness of transition from one subject to another, and by enabling us to avail ourselves of such pauses, in order to bring such incidental remarks as we may deem expedient. Such being the case, we venture again to remind our readers that the plans here presented to them, are intended merely to furnish ideas in respect to form and arrangement; for, as we ourselves are perfectly aware, they would require to be more or less modified, in order to adapt them according to the other—and to us, of course, unknown—circumstances attending any given case. For more frequently than not, probably, it would be considered necessary to retrench and simplify them, to consult effect less and economy more. Accordingly there is very little danger of their being borrowed from in so direct a manner, that application of them would be tantamount to plagiarism, more especially, as hardly any two persons would produce the same design from the same plan.

Should any one be of opinion that those here produced might be greatly improved upon as regards further development of the ideas contained in them, great would be our satisfaction at finding any of them so turned to account, or otherwise corrected and matured. It is possible, however, that a very different construction may be put upon our motives, and that it will be thought to betray somewhat too much of self-complacency, if not of arrogance, on our part, to suppose that our suggestions can be of any value to other persons. Such presumption, if presumption it be, we, of course, partake in common with all who publish designs of their own; but with this difference, that while they give entire plans of houses, as if they were so many perfect models in every respect, we merely throw out partial hints, without presuming to dictate any further. In so doing, we of course leave it to be inferred that we think sufficiently well of our ideas as to imagine they may possibly prove serviceable to others, and of the two, it is surely less offensive to suppose that architects can have occasion for any promptings of such kind, than that they can at all require studies for the arrangement of ordinary houses, or can obtain fresh instruction from plans which are, for the greater part, of the most familiar and every-day character.

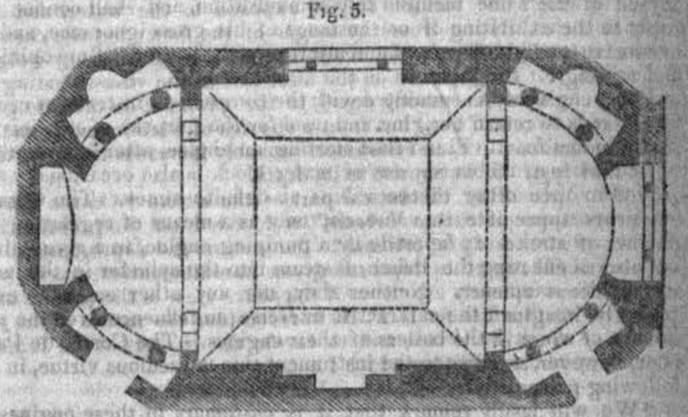
On the other hand, it may fairly be urged against ourselves and our Episodes, that the latter manifest too much straining after novelty and architectural display; that no regard is paid in them to economy, and that, in fact, they are applicable to general purposes, nor at all likely to suit the taste of persons in general. This is too true for us to attempt to contradict it; we leave persons in general, be they architects or those who employ them, to adhere to the present jog-trot system, taking no thought or study in regard to effects arising out of plan and varied combinations, but satisfying themselves that every thing in regard to plan is accomplished, provided that the number of rooms of the dimensions required be obtained, and mere convenience sufficiently attended to, which last, however, is far from being invariably the case, where the plan is only divided into so many squares and parallelograms.

It is not the least ill consequence of all attending the routine system we would fain break through and abolish, that by excluding variety of form in plan, it likewise excludes what would else suggest fresh ideas in regard to style of fitting up, and decoration. Most undoubtedly much character may be given to a room of the simplest and most usual form, yet it is seldom done, and seems to be as seldom attempted. On the contrary, there is a certain established uniform into which rooms of the same class are put almost indiscriminately, without regard to other circumstances. This is more particularly the case with regard to dining-rooms, for which it seems to be laid down as a rule that they have as little architectural attraction as possible bestowed upon them, in fact, show little more than plain walls of a single tint. As a general rule this is, we admit, a wholesome and safe one enough, because, if it admits nothing to gratify, it excludes much that might offend the eye. The very monotonousness and plainness are, besides, characteristic in themselves, so far as such a room is thereby sufficiently distinguished from the others in a house. Still, equal distinction, we conceive, could be kept up, equal propriety of character be maintained, with far greater variety of design; because simplicity and sobriety are by no means restricted to any one mode in particular; neither is the same degree of them desirable upon every occasion. What in one case would be modest elegance, may in another prove scarcely better than chilling nakedness and monotonous dulness. Where all else is plain and unpretending, an air of quiet homeliness and even snugness is becoming enough; but where plate is profusely displayed, and all the appointments of the table are of a sumptuous kind, some corresponding degree of show in the room itself can hardly be an inconsistency. Not only cheerfulness, but festivity of appearance will be perfectly in character, care of course being taken that the particular character be distinctly in accordance with the particular purpose of the room itself. Some variety of colouring is admissible, and though we would exclude *pictures*, we would freely admit *paintings*, that is of a light decorative cast, and as subsidiary to architectural character, such as borders and narrow upright panels at intervals, with arabesques or single figures *en camaieu*, or on a marbled ground. But as to oil pictures in frames, we consider them very ill-suited for dining-rooms, notwithstanding that they are frequently to be met with in them, and are almost the only decorations that are. As far as effect goes, the frames are of more importance than the pictures themselves, which, let them be ever so worthy of examination, are not likely to obtain it, unless attention be pointedly directed to them. Oil pictures are much better adapted for morning than evening rooms; since, so far from at all showing themselves to advantage by artificial light, many of them rather give a room a sombre though rich appearance at such time, unless the room happens to be lighted up expressly for the purpose of exhibiting the pictures themselves.

But all this while we are forgetting our "Episodes," or rather our main subject, and indulging in lengthy episodical remarks grafted upon it, and from which we will now make a transition by quoting an example of a dining-room that was certainly a frequent architectural episode in the interior of Carlton House, we mean the circular one on the principal floor, for the "Gothic" dining-room at the east extremity of the lower apartments towards the gardens, was a positive monstrosity—almost as vile and trumpery in taste as can be conceived. The other was an octastyle Ionic rotunda, extended by four deep recesses or alcoves radiating to the centre of the plan, consequently expanding inwards. We are not aware of any thing similar having been done in any other room of the kind; and yet not only is the plan exceedingly beautiful in itself, but one that admits of numerous variations, to say nothing of the great diversity of design it allows and even suggests, in other respects.

By way of contrast to the plans we gave in the first instance, we now show one for a dining-room whose ends are concave and semicircular, but whose plan is of peculiar character, there being small recesses with columns, between which there is at one end of the room a third recess for the side-board, at the other a window. Any arrangement of this kind would produce an unusual degree of architectural play and richness, with somewhat of intricacy, but not such as to produce confusion or disturb the regularity, if not simplicity, of the ensemble, since the individual parts and recesses are sufficiently connected together by the columns and antæ, disposed semicircularly.

Fig. 5.



The idea itself admits of being so variously shaped, of being taken as the germ of so many distinct designs, not for a dining-room alone, but for apartments of other kinds, that were we at all at a loss for subjects, we could make it serve us for a great many Episodes. For instance, supposing the plan to admit of it, the same arrangement would be exceedingly well adapted for a library or morning-room with a window at each end, the four recesses, either with or without columns, being filled up with bookshelves, and either a single door opposite the fire-place, or two doors in the angles on that side of the room as circumstances might require. Else there might be a window there as at present, and three recesses for book-cases at each end of the apartment

In regard to the plan here shown as that for a dining room, it is not proposed as one capable of being strictly followed, because it would stand in need of more or less alteration in order to adapt and adjust it, so as to combine advantageously with the rest. Of course it is here presumed that there is nothing to hinder its being executed precisely as it is represented in the cut. The door near the sideboard is supposed to open into a corridor communicating with the offices, and the other from a vestibule or ante-room, as the case might be. There are four pedestals for candelabra, and there might be others in the two arches within the recesses: these, however, are not absolutely essential to the design, but might be adopted or omitted according as more or less decoration should be held desirable,—a point to be regulated by the scale of embellishment fixed upon. The recesses and semicircular ends of the room are supposed to be floored with ornamental tiles or mosaic (like the saloon of the Reform Club), and the square or centre part to be covered with a rich carpet. Or else the whole might be carpetted, and the same kind of distinction be nevertheless kept up, by putting down plain carpetting of some quiet neutral tint at the ends, for the purpose of giving more importance to the middle compartment of the room, and to the two extreme ones somewhat the air of being spacious semicircular alcoves with smaller recesses within them. After all, however, the propriety of so doing would depend upon whether any corresponding sort of distinction between the several divisions of the room was observed in the design of the ceiling. Should the situation of the room be such as to admit of the centre being lighted from above, the ceiling might then be raised by a cove, and have a lantern occupying the rest of it. In such case no side windows would be required, still the one at the end of the room might be retained, unless it should be preferred to make a second sideboard recess corresponding with that at the opposite end, or to have these folding doors opening from an ante-room, substituting a niche for the present door in the recess on the left hand.

(To be continued.)

ON THE FORMS AND PROPORTIONS OF STEAM VESSELS.

Though reluctant to call in question the opinions of so able a writer as "H. P. H." appears to be, I think he has no authority for multiplying the "sectional *area* of the immersed parts" of a steam vessel, into the (mean) *depth* below the surface of the water, in order to find the resistance to her motion. Doubtless this would be correct for "flood-gates," of which one surface only is exposed to the water, and the pressure is that arising from the *weight* of the fluid; but the case of a vessel is totally different, the resistance arising not from any weight of the fluid, (for the pressure on the after half of the vessel tending to push her forward, is exactly equal to the pressure on the fore part which tends to retard her,) but from a species of friction and from the inertia of the fluid. This resistance probably increases in porportion to the *density* of the water, not to its *depth*.

As the whole of the theoretical part of the article "On the Forms and Proportions of Steam Vessels," is founded on the presumption that the resistance is proportional to the section and depth, instead of section without regard to depth, as given in mathematical works, and as it will be completely erroneous if the above view is the correct one, it may be worth while for H. P. H. to reconsider the nature of the resistance of which he writes, and to favour the readers of the Journal with his opinions—waiting which I am,

Very respectfully,

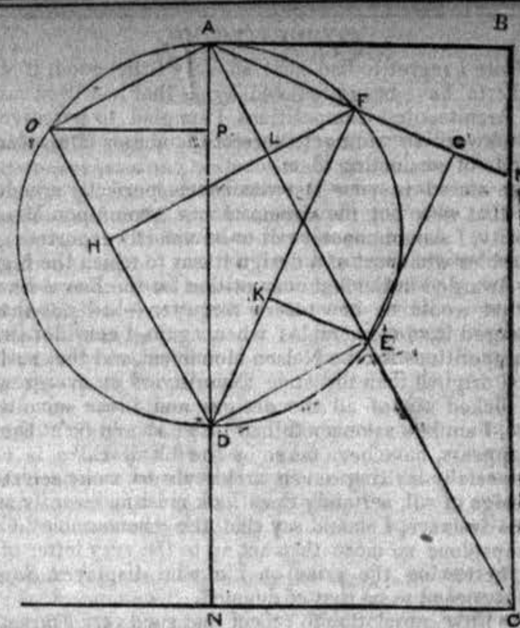
A. M.

Neath, 11th of 9th month, 1841.

ON THE STRAIN OF BEAMS.

Sir—It may be interesting to trace the effects on beams of strains acting on them in a parallel direction. In the common hand punch, for example, there is an upright beam bent at right angles at top to a convenient distance, the extremity being fitted to receive the reaction of the plates under the punch. Here the strain on the beam is upward. Instances of similar downward strains, too, are familiar, as in some portable balances, in which the scales hang from the extremity of an upright standard bent forward at the upper end.

Let A B C be an upright standard rising perpendicularly from the sole N C. and bent at right angles at B; let it be subjected to a force



acting downwards in the line A N parallel to B C. Then it would appear on a general view, that the part B C will be equally affected throughout, as the force, which let A D represent, has the same leverage on all points of B C.

But, more particularly, in estimating the action of the force on any point M, we may consider it as acting on M by the imaginary straight lever A M. The action of the force A D on M may be analysed by drawing D F perpendicular to A M; A D = A F and F D, the former being longitudinal pressure along A M, the latter, a lateral strain on the cross section at M by the leverage A M. Similar resolutions for other points in B C will form right angled triangles on the common base A D, and thus the locus of the vertices of these triangles is a circle described on the diameter A D, passing through point F, of course.

To ascertain how the forces A F, F D, acting on the section M, affect any other section, as that at the base C, draw A C cutting the circle at E, join D E, and complete the parallelogram O E; draw F H perpendicular to O D, cutting A E and O D at L and H. Then A F = A L and L F, and F D = D H and H F, these four resultants all acting at point A on lever A C; the sum of the longitudinal strains is A L + H D = A L + L E = A E; the lateral strains L F and F H, acting in opposite directions = F H − F L = H L = D E. Thus the resultants of the forces A F, F D, acting on the section M, are A E and E D on section C. But A E and E D are also the resultants of A D acting directly on section C. It appears, then, that the effect of the force A D on the section C is one, whether acting directly by A C, or indirectly by A M C. Again, the reciprocal action of the forces A E, E D, acting directly on C, upon the section M, may be had by drawing E K, E G perpendicular to D F, A M respectively. For we then have D E = E K and K D, and A E = A G and G E. Then G E or F K + K D = F D, and A G − K E or F G = A F. But A F and F D are the resultants of A D acting directly on M. Therefore, as M and C represent every two points in B C, and as the direct action of the force A D on either point is identical with its indirect action through the other point, we conclude, generally, that its action on every cross section of B C is constant, and therefore B C ought to be of equal dimensions from bottom to top. Draw O P perpendicular to A D, then A O = A P and P O, and D O = O P and P D, and as P O in these two quantities acts in opposite directions, we have A O and D O = A P and P D = A D, which intimates that there is no lateral thrust on the standard, so that the cross section of B C may at once be determined from the quantities A D, N C. The part A B ought to have the parabolic outline, modified when the corner B is rounded.

By supposing all the forces reversed in direction, the above demonstration will apply also to standards subjected to upward strains.

I am, Sir,

Your obedient servant,

Daniel Clark.

Phœnix Iron Works,
Glasgow, 20th Aug.

P.S. I think it would be a great improvement to introduce symbols to express the most common terms in papers of the nature of the preceding: ○ for *circle*, ⊥ for *perpendicular*, &c.

COMPETITIONS.

Sir—While I regret to find that so very little good, if any at all, should hitherto have been produced by all that has been said on the subject of Architectural Competitions, I am glad to perceive that you are not backward in aiding to correct the abuses now attending the present mode of conducting them.

The case stated in your last number is perfectly scandalous and flagitious, that were not the circumstances given upon Mr. Godwin's own authority, I should conceive it to be unfairly reported. And yet when I consider what sort of a design it was to which the highest premium was awarded in the first competition for the Royal Exchange,—a design that would be now utterly forgotten—had not that circumstance rendered it so memorable; when, again, I consider the result of the two competitions for the Nelson Monument, and that nothing more tasteful and original than the stale absurdity of an overgrown column could be picked out of all the designs and ideas submitted to the Committee, I am less astonished than I else should be at the *measures* which, it appears, have been taken by the "Tailors."

After especially inviting seven architects to make selection of the poorest design of all, certainly does look most awkwardly suspicious. Still, in this instance, I should say that the "honourable" Committee have perhaps done no more than act up to the very letter of their engagement, bestowing the prize on him who displayed *Superiority*—though it happened to be that of demerit.

It is some little consolation to reflect that such very flagrant instances may in time have the good effect of stiring up the profession to unite cordially and vigourously in devising such measures as should in future protect them from such swindling,—and to give it, would be almost to countenance it. Any sort of delicacy towards persons who scruple not to lend themselves to such dirty doings, would be sheer weakness. Better would it be were the names of all the parties—all the "highly respectable" individuals, concerned in such transactions, shown up to the public. A little pillorying of that kind would do a vast deal of good, and serve to render such respectable gentlemen either a little more cautious or a little more adroit. If they must be rogues there is no occasion for them to show themselves such arrant bunglers also, as they now generally do.

I remain, &c.

Vindex.

Sir—Eventually the evils arising from the present system of public and limited competitions will work their own cure, as architects who love their profession and desire to uphold its respectability will pause ere they lend themselves to the gross jobbing, and party interest which so generally occurs on such occasions. It seems to me that as a body we are heaping insult upon our own heads by the submission of designs (generally—if not always—the result of mature deliberation), to men seldom possessing an atom of architectural taste, or any other qualification requisite to render them efficient as judges of the works placed at their disposal for acceptance or rejection. I would advise my friend Mr. Godwin to keep an eye upon the Tailors he alludes to in your last number, (page 310), as no doubt they have been at their usual dirty work, and have "cabbaged" portions from each of the designs entrusted to their care; with regard to the Paddington Church job I happen to know very little about it, but should think, if all we hear is true, that for the credit of the Committee, "the least said is the soonest mended."

Having myself done with public competition, I may be permitted to add my opinion that architects competing should do so only upon the understanding that members of their own body should be their judges, as regards the comparative architectural merit and fitness of the several designs, and the more fairly to do so I would suggest that each candidate in turn should examine and compare the designs, and omitting his own, should give in a written opinion upon their several degrees of excellence; the decision thus come to could hardly fail in being a just one, while by this means the first, second and so forth would be pointed out without any chance of favouritism, and each of the judges having in his own case been compelled to study the whole work minutely, he would thus be the better qualified to give an opinion upon the productions of others; this proposal no body of persons advertising for designs could reasonably object to, if they wish to have erections throughout the land, which are to remain monuments of the talents of their respective architects, and of their own taste in expending the means committed to their disposal.

The success of some of the profession, who (like itinerant vendors of tea, millinery, &c.) scour the country in the various directions pointed out by the public advertisements, and earwig the Committees, may induce them for a time to follow up competition as a thriving trade; but I feel assured such a system cannot last, it only requires those architects who honour their profession, to unite in upholding its respectability, by refusing to enter into any competition unless it is regulated in some equitable and consistent manner, and in the long run they must succeed. The two last competitions that I had any thing to do with were the Infant Orphan Asylum and the Tower of Wandsworth church, at the first the architects were limited to 20,000*l*. as about the sum to be expended, and in order that this stipulation should be attended to, all the parties competing were required to furnish detailed quantities of their several designs, in defiance of this stringent clause, which of course sate like an incubus upon the ideas of the greater number who sent in—a design was chosen, the lowest tender for the execution of which was about 33,000*l*.; in this case two premiums were offered, one of 100 guineas and one of 50 guineas, the second of which only was awarded, thus: those who conformed to the printed regulations were excluded from participating in the first premium, while those who did not reaped the whole benefit; and I maintain that the Committee were bound in justice to those who obeyed the instructions, to have awarded both premiums, if to please themselves they chose to execute a more expensive design.

In the second case, namely, that at Wandsworth, the present Tower of the Church being in a very dilapidated state, the parish deemed it necessary that something should be done, and the result of their deliberations was that architects should be invited to send in plans, &c. for a new Tower, to cost 1,000*l*., which sum they were willing to expend; but lo! when the designs came before them, they, contrary to the above case, considered economy to be the order of the day, and they in consequence awarded their premium to a design to cost 500*l*. only, and thus again those who conformed were laid on their backs, but it did not rest here, for after their economical decision in came the *extreme* economists of various denominations unconnected with the church, and at a subsequent meeting decided on curtailing the edifice of its intended fair proportions, by actually carrying a resolution to repair the already condemned and ruinous old Tower, at a still less expense; but the tables are turned, the work (I am given to understand) is stopped, the builder is afraid to proceed, and the architect refuses or rather suspends any other opinion but that he is to complete his contract; thus the parish are literally in a pretty situation between two stools, and have no one to thank but themselves. While from the want of rule in competitions as shown in the above cases, the profession never have any guarantee that their productions will be judged by any uniform and equitable rule, but find themselves put out of court sometimes because they are not sufficiently gorgeous, and sometimes because they are too expensive, while in both cases they have strictly conformed to the instructions given.

I am, Sir, your obedient servant,

John Burges Watson.

39, *Manchester Street, Manchester Square,*
September 7, 1841.

Sir—Reading in your valuable Journal for this month, some curious statements respecting "Competition Designs." I beg to state a case which happened to me some time since at Shrewsbury, which I think will surpass, in richness of facts, any I have yet read about.

A premium of 10*l*. was offered, publicly, for the best plan of a chapel to be erected near the town of Shrewsbury. The vestry were to be the judges.

They met at the publicly advertised time, and selected my design, and their officer informed me of the fact.

Not hearing any thing more about the matter for some time, I called at the vestry-room, and inquired how things were going forward.

And, Sir, what do you think was the answer I received, from the same functionary who had previously charmed my heart by giving the information previously stated? A cheque for the 10*l*. was—*not* handed over; nor was any order from the vestry given for me to proceed with the work. But still—"something" was given me which astounded me equally with either, and that was a grave address from the aforesaid officer, in the following words:—They have now given the premium to ————.* My feelings were of course those of surprise and astonishment, and almost *disbelief*; but the latter was soon expelled on receiving from my informant the *reasons* which actuated the "vestry." "The fact is this, Mr. —— assured some of our vestry that if they thought proper to give the premium to him, he would hand it over to one of the town charities, and they thought as now they could not commit a a nobler hact." This you will say *was* a noble act.

Your's, truly,

Veritas.

* An architect who lived in the town and parish.

NEW ACTS OF PARLIAMENT.

There have been introduced, by Lord Normanby (the late Secretary of State) into the Houses of Parliament, three very important Bills connected with the profession, which demand their immediate and especial attention. The bills are too long to be transferred entirely into our Journal, but we shall give an abstract of the most important clauses in each Bill, which will show their general character.

REGULATION OF BUILDINGS IN LARGE TOWNS.

Abstract of a Bill intituled "An Act for regulating Buildings in large Towns," which has passed the House of Lords, and is now before the House of Commons.

1. WHEREAS disease is engendered and aggravated by the crowded and unhealthy manner of building the dwellings of the working classes in the large towns and populous places of this realm, and it is expedient to make provision for improving such dwellings: be it therefore enacted, &c., That the council of every borough which is within the provisions of an act passed in the sixth year of the reign of his late Majesty, intituled "an Act to provide for the Regulation of Municipal Corporations in England and Wales," or of any charter granted in pursuance of that or any subsequent act, and of every borough which is within the provisions of an act passed in the fourth year of the reign of her Majesty, intituled "an Act for the Regulation of Municipal Corporations in Ireland," and the magistrates and councils of every royal burgh and parliamentary burgh in Scotland, and of every burgh of barony or of regality in Scotland under the government of magistrates and councils, and also in England and Ireland the justices of the peace in general or quarter sessions assembled, and in Scotland the sheriff, having jurisdiction in any other town or place which her Majesty, with the advice of her privy council, shall order to be within the provisions of this act, shall, within six calendar months next after the passing of this act, or next after such order, and from time to time as vacancies shall happen, appoint a fit person, or so many fit persons as the council or justices or sheriff respectively shall think fit, not being surveyors of the estates of the mayor, aldermen, and burgesses of any borough, or of the corporation of any burgh, in which they are appointed, to be surveyors of buildings in such borough, town, or place, and to see that the several provisions of this act are observed therein; and each of the said surveyors shall have in his special charge such district of the borough, town, or place for which he is appointed as the council or justices or the sheriff shall in that behalf appoint; and each of the said surveyors shall hold his office during the pleasure of the council or justices or sheriff by whom he is appointed, and may, if the council or justices or sheriff shall so think fit, but not otherwise, have an assistant or assistants under him (such assistants being in all cases appointed by and holding their situations during the pleasure of the council or justices or sheriff); and the council or justices or sheriff shall have authority to fix the districts in which the said surveyors are to act within the borough, town, or place, and to do all things relating in anywise to the appointment and direction of such surveyors and assistant surveyors: provided always, that if a charter of incorporation shall be granted to any town or place in which such surveyors or assistant surveyors have been appointed, the future appointment of such surveyors and assistant surveyors shall be vested in the council, as if such town or place were incorporated at the time of the passing of this act.

2 and 3 enacts, that surveyors are to make declaration, to diligently, faithfully, and impartially perform the duties of the office; the council or justices or sheriff shall provide an office for the said surveyors.

4, Surveyors to be paid by fees, not exceeding for a first rate building 3*l.* 10*s.*, second rate 3*l.*, third rate 2*l.* 10*s.*, fourth rate 2*l.*, fifth rate 1*l.* 10*s.*, sixth rate 1*l.*; and for every alteration or addition to any building, a sum not exceeding half the above.

5, Powers given to councils of boroughs by this act to be exercised in Oxford by commissioners under act 11 G. 3, for improving the city of Oxford.

6, The surveyors appointed under any of the acts specified in the schedule (London, Bristol and Liverpool), shall be the surveyors for enforcing so much of this act as is to be enforced within the limits of the said several acts, and shall be entitled to receive for their trouble herein such additional fees as shall be ordered and settled by the authority by which they are appointed.

7, Notice of building or altering premises to be left at the surveyor's office.

Clauses 8 to 15, regulations for fees, duties of surveyors, penalties for default of notice, workmen offending and refusing inspection.

16, That it shall not be lawful to build within the limits of this act any house in which the floor of any room or cellar to be used as a dwelling* shall be below the surface or level of the ground in the immediate neighbourhood of such house, unless there shall be an open area not less than three feet wide from the floor of such room or cellar to the top of the area adjoining to the front or back of such room or cellar, and extending from one side or party wall to the other side or party wall; but this enactment shall not be taken to prevent any archway or covering which may be laid across such area for the purpose of approaching the doorway of the house.

* We consider that the words here used require to be particularly defined if they mean any room that is used for domestic purposes, such as a kitchen forming part of a dwelling house, the act will then effect a very serious injury on nearly half the houses in London; if dwelling mean a room wherein any person sleeps, then we do not see any objection to the Act, but in such case it would be better to alter the word *dwelling* to *sleeping room*.—EDITOR.

17, That in any house to be built within the limits of this act after the passing thereof it shall not be lawful to let separately, except as a warehouse or storehouse, or to suffer to be occupied for hire as a dwelling place,* any underground cellar or room not having a window and fireplace, as well as such an open area adjoining thereunto, as is herein-before specified.

18, Enacts, that in any house built within the limits of this act before the passing thereof it shall not be lawful to let separately, except as a warehouse or storehouse, or to suffer to be occupied for hire as a dwelling place, after the first day of January 1845, any underground cellar or room not having a window, or after the first day of January 1848, any underground cellar or room not having, in addition to such window, such an open area not less than two feet wide, as is herein-before described, or after the first day of January 1851, any underground cellar or room not having a fireplace in addition to such window and area.

19, Enacts, that every person who shall wilfully let or suffer to be occupied any underground cellar or room contrary to the provisions of this act shall forfeit and pay the sum of 20*s.* for every day that such cellar or room shall be so occupied, to be recovered by action of debt, either by the person occupying such cellar or room, or any other person who will sue for the same.

20, Enacts, that on any *new foundation* within the limits of this act it shall not be lawful to build any house, except corner houses, and houses built in a street or thoroughfare which was begun or laid out, before the passing of this act, under the authority of any act of parliament, unless there shall be a clear space of at least 20 feet wide between the back wall of such house and the back wall of any opposite house: provided always, that in estimating this distance no account shall be taken of any back addition or outbuilding belonging to either of such houses not more than half the height of the back wall of the house above the level of the street, and which addition or outbuilding shall not extend along more than two-thirds of the whole width of the house to which it belongs; but no such addition or outbuilding shall be nearer than seven feet to any other house, or to any addition or outbuilding to any other house, except privies, sheds, or other buildings, not more than eight feet high above the level of the street which may adjoin the fence or fence wall on either side.

21, Enacts, that it shall not be lawful to build any new street, alley, or public passage within the limits of this act, except such as were begun or laid out before the passing of this act, under the authority of any act of parliament, unless the houses therein shall be separated by at least 30 feet where there is a carriageway between such houses, or at least 20 feet in the case of alleys and foot passages where there is no carriageway.

22, Enacts, that it shall not be lawful to build within the limits of this act any new court or alley (except mews and stable yards) narrower than 30 feet, through which there shall not be an open passage at each end thereof at least 20 feet wide, and entirely open from the ground upwards.

23, Enacts, that the level of ground floor of every house which shall be built within the limits of this act shall be at least six inches above the level of the footway or road adjoining such house.

24, Enacts, that no room which shall be built within the limits of this act to be used as a dwelling on the cellar or ground floor, or elsewhere than in the upper story of any third rate house, or any house of a lower class or rate than the third, as defined by the said several acts named in the schedule (London, Bristol and Liverpool), within the limits of the said acts respectively, and elsewhere as defined by this act, shall be less than eight feet in height from the floor to the ceiling, and no room in the upper story of any such house shall be less than seven feet in height from the floor to the ceiling.

25, That there shall not be more than one story in any part of the roof of any house or other building which shall be built within the limits of this act.

26, That no third rate or lower rate of house, defined as aforesaid, except houses in a street or thoroughfare which was begun or laid out, before the passing of this act, under the authority of any act of parliament, shall be built within the limits of this act without an enclosed yard, which, exclusive of any buildings therein, except the privy (if any), or any shed or other building not more than eight feet high, shall be of the extent of one-sixth part at least of the ground covered by the house; and no house shall be built within the limits of this act without a privy, with proper doors and coverings to the same, either in the house, or in the yard attached to the house, and sufficiently screened and fenced from public view, to the satisfaction of the surveyor of the district.

27, All buildings erected contrary to this act to be abated.

28, Provides for preventing neglect or evasion of this act.

29, And whereas it is expedient that further provisions for security against fire should be made in such boroughs and towns as aforesaid which are not within the provisions of any of the acts named in the said schedule (London, Bristol and Liverpool); be it enacted, that all buildings begun to be built or rebuilt in any such borough or town not within the provisions of one of the said acts shall, after the passing of this act, be built and rebuilt according to the regulations herein-after contained, and the outer walls, party walls, separate side or end walls, chimney backs, and chimney flues shall be built according to the schedule (A.) annexed to this act: provided always, that where there is more than one story below the level of the street the walls of the lowest story shall be half a brick or four inches and a half thicker than is otherwise required.

The remainder of the clauses apply to provincial towns, and are framed somewhat similar to the Metropolitan Building Act. The annexed schedule explains the thickness of the walls and the classes of buildings.

SCHEDULE (A).

DESCRIPTION OF BUILDINGS.	THICKNESS OF OUTER WALLS.				THICKNESS OF PARTY WALLS.*				
	In Cellar Story to under side of Ground Story Floor.	In Ground Story to the top of joists in floor above Ground Floor.	Above to the top of the Wall, or, if a Parapet, to the upper side of the ceiling of the Top Story.	Parapet.	In Cellar Story to under side of Ground Story Front.	In Ground Story to the top of joists in floor above Ground Story.	Above to the top of joists in floor above First Story.	Above to under side of the ceiling of the Top Story.	Above through the roof to the Top.
First Rate. Every Church, Chapel, and other Place of Public Worship, Brewery, Distillery, Manufactory, Warehouse and other Building (not being a Dwelling House or a Building in the Fifth or Sixth Class) which is higher than 31 feet. Every Dwelling House which is higher than 50 feet, or which contains more than nine squares of building on the Ground Floor—every Dwelling House or other Building which has more than three clear stories above ground.	2 B. or 17½ In.	2 B. or 17½ In.	1½ B. or 13 In.	1 B. or 8½ In.	2½ B. or 22½ In.	2 B. or 17½ In.	2 B. or 17½ In.	2 B. or 17½ In.	1½ B. or 13 In.
Second Rate. Every Warehouse or other Building (not being a Building in the First, Fifth, or Sixth Class, or a Dwelling House,) which is higher than 22 feet, or which has three clear stories above ground. Every Dwelling House (having three clear stories and no more above ground) which is higher than 40 feet, and every Dwelling House which contains more than five and not more than nine squares of building on the ground floor.	1½ B. or 13 In.	1½ B. or 13 In.	1 B. or 8½ In.	1 B. or 8½ In.	2½ B. or 22½ In.	2 B. or 17½ In.	2 B. or 17½ In.	1½ B. or 13 In.	1½ B. or 13 In.
Third Rate. Every Warehouse and other Building (not being a Dwelling House or a Building in the first, second, fifth, or sixth class,) which is higher than 13 feet, or which has two clear stories above ground. Every Dwelling House (having three clear stories and no more above ground) which is higher than 37 feet. Every Dwelling House which contains more than three squares and a half and not more than five squares of building on the ground floor.	1½ B. or 13 In.	1½ B. or 13 In.	1 B. or 8½ In.	1 B. or 8½ In.	2 B. or 17½ In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.
Fourth Rate. Every Warehouse and other Building (not being a Building in the first, fifth, or sixth class,) which is not higher than 13 feet. Every Dwelling House (having two clear stories and no more above ground) which is higher than 25 feet. Every Dwelling House which has not more than one clear story above ground, or which does not contain three squares and a half of building on the ground floor.	1½ B. or 13 In.	1 B. or 8½ In.	1 B. or 8½ In.	1 B. or 8½ In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.	1½ B. or 13 In.	1 B. or 8½ In.

Fifth Rate.

Every Building (not being a Building of the first class or a Dwelling House) which is at least four feet and not more than ten feet from any Public Street, Road, or Way, and at least sixteen feet from any other Building not in the same possession, or connected with any such Building only by a fence or fence wall, may be built of any dimensions, but must be built either of brick or stone, or covered with incombustible materials.

Sixth Rate.

Every Building, not in the first class, which is at least ten feet from any Public Street, Road, or Way, and at least thirty feet from any other Building not in the same possession, or connected with any such Building only by a fence or fence wall, may be built of any dimensions and with any materials.

* Separate Side or End Walls between Buildings shall not be less than the length of one brick or 8½ inches thick, or, when the wall is higher than 24 feet, less than the length of one brick and one half, or 13 inches thick.

Where any Building is not founded on rock, every Outer or Party Wall shall have at least four footing courses below the level of the Cellar floor, each two courses projecting 2¼ inches on each side of the course or wall immediately above them; and all Inner Walls shall have at least two footing courses 4½ inches wider than the wall above them; and all such footings shall commence upon a firm natural or artificial foundation to be approved by the Surveyor.

DRAINAGE BILL.

Extracts from a Bill intituled "An Act for the better Drainage of Towns and Villages," which has passed the House of Lords, and is now in the House of Commons.

1. WHEREAS there is great need of sanatory regulations in the towns and populous places of this realm, especially for want of sufficient means of drainage, whereby disease is engendered and aggravated; be it therefore enacted, &c., that after the passing of this act it shall not be lawful to build any house within the limits of this act, unless a drain be first constructed to the satisfaction of the commissioners of sewers having jurisdiction there, of such material, size, level, and fall as they shall direct, which drain shall lead from the intended site of such house to such common sewer, common drain, or common watercourse as the commissioners shall direct, or if there be no such common sewer, common drain, or common watercourse within 10 yards of any part of the intended site of such house, then to such cesspool or other place as the commissioners shall direct, not more than ten yards from some part of such intended site.

2. That in all cases where any house built within the limits of this act, either before or after the passing thereof, shall not be drained by a sufficient drain communicating with some common sewer, common drain, or common watercourse, to the satisfaction of the commissioners of sewers, and if a sewer, drain, or watercourse of sufficient size, under the jurisdiction of the commissioners of sewers, and which they shall think fit to be used for draining such house, shall pass along any public thoroughfare or way in front of or behind any part of such house, it shall be lawful for the said commissioners to give notice in writing, signed by any surveyor or officer appointed by them for that purpose, to the occupier of such house, requiring such occupier or the owner thereof forthwith, or within such reasonable time as shall therefore be appointed by the said commissioners, to construct a covered drain of such materials, size, level, and fall as the commissioners shall direct, from the said house to the said sewer, drain, or watercourse; and if the owner or occupier of such house shall refuse or neglect, during 28 days next after the said notice shall have been delivered to such occupier or left at such house, to begin to construct such drain, or shall thereafter fail to carry it on and complete it with all reasonable despatch, it shall be lawful for the said commissioners to construct the same, and to recover the expences to be incurred thereby by distress and sale of the goods and chattels either of the owner or of the then present or any future occupier of such house as herein-after mentioned, by warrant under the hands and seals of six or more or the said commissioners.

3. That whenever any house shall be rebuilt within the limits of this act, the level of the lowest floor shall be raised sufficiently to allow of the construction of such a drain as is herein-before provided in the case of houses to be built after the passing of this act, and for that purpose the levels shall be taken and determined under the direction of the commissioners of sewers; and whenever any house shall be taken down as low as the floor of the first story, for the purpose of being built up again, such building shall be deemed a rebuilding within the meaning of this act.

4. The level of every new street, court, alley, and place which shall be made, and also the level of every street, &c. in which any new common sewer or common drain shall be made, shall be fixed under the direction of the commissioners of sewers.

5. The commissioners of sewers shall have authority, from time to time, as they shall see fit, to widen, deepen, embank, alter, arch over, amend, clean, and scour all or any of the sewers, drains, watercourses, sinks, vaults, cesspools, and privies within their jurisdiction, and also to cleanse, drain, amend, and abate all stagnant ponds and other nuisances whereby the health of the neighbourhood is or is likely to be affected, and to make new sewers, drains, sinks, cesspools, or vaults where none formerly existed, and also to make reservoirs, engines, sluices, penstocks, or any other works for better draining any place within their jurisdiction, in, under, or across all or any of the public ways, thoroughfares, or places within their jurisdiction, and, if needful, through and across all underground cellars and vaults which they shall find under any of the said public ways and thoroughfares, doing as little damage as may be, and making due compensation for the damage done to the owners and occupiers thereof; and in case it shall be found necessary, for completing any of of the aforesaid sewers or drains, to build, carry, and continue the same into and through any inclosed lands or other place, not being a public way, it shall be lawful for the said commissioners to build, carry, and continue the same into or through the said lands or other place accordingly, making due compensation to the owners and occupiers thereof; and all such sewers and other works and premises shall be at all times under the control, care, and management of the said commissioners, and of their surveyors and officers.

6. It shall be lawful for the commissioners of sewers, at their discretion, to abandon any common sewer or common drain running through narrow courts or alleys of houses or inclosed places, or through or under any place not being a public way, in all cases wherein a new common sewer or common drain shall be constructed, in any public streets, roads, or highways contiguous thereto, and capable of receiving the drainage of such courts, alleys, or inclosed or other places; and that upon such drainage being turned into such new sewer or drain the said commissioners shall not thereafter be obliged to maintain the sewers or drains so to be abandoned, but shall order the same to be filled up at their discretion, and that all branch drains communicating with any sewer or drain so to be abandoned shall be turned by the owners of the lands and tenements theretofore drained thereby into the new sewer or drain to be constructed instead of such abandoned sewers or drains, by making drains into such new sewers or drains, conformably to the regulations of the commissioners of sewers: provided always, that if such new sewer or drain shall not be brought within the distance of ten yards from the lands or tenements formerly drained by the abandoned sewer or drain, the cost of completing the branch drains beyond the length of 10 yards shall be defrayed by the commissioners of sewers.

7. Commissioners to give 28 days notice and provide a plan and section before making any new common sewer or common drain under this act, where no common sewer or common drain already existed, and before abandoning any old common sewer or common drain, and before abating any such nuisance as aforesaid.

10. That before making any drain or watercourse for the purpose of draining water directly or indirectly from any land or tenement into any common sewer, &c., and also before beginning to lay or dig out the foundations of any house therein, or to rebuild any house therein, 14 clear days notice in writing shall be given to the commissioners; such new drain or watercourse shall be made of such materials and workmanship, and laid at such level, as is provided by this act, and under such regulations as the said commissioners shall order.

11.* That it shall be lawful for the commissioners, or for their surveyor or such other person as they shall appoint, to inspect any drain or watercourse within their jurisdiction, and for that purpose *to enter at all reasonable times, by themselves, or their duly authorized surveyors, officers, and workmen, upon any lands and tenements, and also to cause the ground to be opened in any place they shall think fit*, doing as little damage as may be; and if such drain or watercourse shall be found to be made to the satisfaction of the commissioners, they shall cause the same to be closed and made good as soon as may be; and the expences of opening, closing, and making good such drain or watercourse shall be defrayed by the said commissioners out of the rates and assessments authorized to be made by them by the laws in force relating to sewers.

12. That all branch drains, *as well within as without the lands and tenements* to which they belong, and all watercourses used for drains, and all privies and cesspools, within the limits of this act, shall be under the survey and control of the said commissioners, &c., and shall be repaired and cleansed at the cost and charge of the owners or occupiers of the lands and tenements to which the same shall belong; and if the owner or occupier of any land or tenement to which any branch drain, watercourse, cesspool, or privy shall belong shall neglect to repair or cleanse the same in the manner required by the said commissioners, during 14 days after notice in writing for that purpose, signed by any such surveyor or officer, shall have been given to such occupier, or left upon the premises, it shall be lawful for the said commissioners to order such branch drain, &c., to be repaired and cleansed, and to levy and recover the costs and expences thereof by distress, &c., either of the owners or of the occupiers so neglecting to repair and cleanse the same.

21. Commissioners shall cause a map to be made of the district within their jurisdiction, on a scale not less than one inch to 400 feet, and to mark thereon the course of every common sewer, common drain, and common watercourse, and shall cause the same from time to time to be altered and amended; and such map, or a copy thereof, with the date expressed thereon of the last time at which it shall have been so amended, shall be kept in the office of the commissioners, and shall be open at all seasonable hours to the inspection of the owners or occupiers of any lands or tenements within the jurisdiction of such commission.

25. Where any common sewer or common drain shall be made by the said commissioners, under any public way where no common sewer or common drain formerly existed, the cost of making the same shall be borne, in the manner herein-after specified, by the several owners of the lands and tenements abutting on such public way on either side thereof, in proportion to the several lengths of frontage so abutting;† and it shall be lawful for the commissioners, when they shall have undertaken the construction thereof, to charge the said several owners with the cost of constructing a common sewer of the usual size‡ in the jurisdiction of the commissioners, to be paid by *five equal yearly instalments*, the first instalment being payable as soon after the completion of the work as the commissioners shall require the same.

26. And whereas by the laws in force relating to sewers the commissioners are empowered to lay separate and distinct rates, as occasion shall require, for every separate and distinct level, valley, or district within their commission, or for any part thereof, whenever they shall think fit to do so; be it enacted, that so much of the cost of making any common sewer or common drain above the usual size which shall exceed the charges herein-before laid upon the several owners of lands and tenements abutting on any public way, and also the costs of making those parts of any common sewer or common

* Clauses 11 and 12 contain very extraordinary powers, and such as are liable to be used with great abuse.—EDITOR.

† For corner houses there ought to be some provision, so as to make them chargeable for one frontage only, and not as is now the case for two frontages.—EDITOR.

‡ We consider that the commissioners ought not to have the power for charging or enforcing in any case more than for what is considered in London as a *second size* sewer. If a *first rate sewer* be constructed, the extra price ought to be chargeable to the whole district drained by it, as provided in the following clause.—EDITOR.

drain which cannot be charged upon any particular owner of lands and tenements, and of widening or deepening any common sewer or common drain already existing, and of repairing and cleansing each common sewer and common drain when made, shall be borne by the owners of all lands and tenements within the level, valley, or district, or part thereof, for which such separate rates are made, wherein such common sewer or common drain is situated.

29. That, subject to the provisions herein contained, the instalments payable for making any common sewer or common drain, and all rates which the commissioners are empowered to assess and shall assess upon any lands or ments within their jurisdiction, shall be recoverable, if not paid, by distress, &c. either of the owner or of the then present or any future occupier of such lands and tenements.

30. No occupier of any land or tenement for a less term than from year to year shall be required to pay, more than the whole amount of rent which was due and payable from him at the time when the notice herein-before mentioned in each case shall have been delivered to him, or left upon the premises as aforesaid, or which shall thenceforth from time to time accrue and become payable by him, unless he shall neglect or refuse, upon application made to him for that purpose by or on behalf of the commissioners, truly to disclose the amount of his rent, and the name and address of the person to whom such rent is payable; but the burden of proof that the sum demanded of any such occupier is greater than the rent which was due by him at the time of such notice, or which shall have since accrued, shall lie upon such occupier.

31. In every case in which any tenant or occupier shall have paid any sum for making, repairing, or cleansing any common sewer, &c., or for making or repairing any branch drain, or any cesspool or privy, in respect of his occupation of such lands or tenements, he shall be entitled to deduct from hi rent such part of the amount so paid by him as is herein-after specified; (that is to say,) if at the time of such payment he is a tenant for an unexpired term of 7 years, or any less term, he may deduct the whole amount paid by him; if for more than 7 years and not more than 14 years, he may deduct $\frac{4}{5}$ thereof; if for more than 14 years and not more than 21 years, he may deduct $\frac{3}{5}$ thereof; if for more than 21 years and not more than 28 years, he may deduct $\frac{2}{5}$ thereof; if for more than 28 years and not more than 35 years, he may deduct $\frac{1}{5}$ thereof; but if for more than 35 years, he shall not be entitled to deduct any part thereof: provided always, that any tenant under a lease containing a covenant for renewal thereof shall be deemed a tenant for the full term to which his holding may be extended under such covenant; and that every tenant for a term depending upon a life or lives shall be deemed a tenant for such absolute term of years as shall be of the same value as such contingent term, according to the government tables for the purchase of life annuities; and every lessor, being himself also a tenant or lessee of any lands or tenements, from whose rent any part of the amount so paid to commissioners shall have been deducted, shall be entitled in like manner to deduct from the rent payable by him to his lessor such part thereof as according to the provisions herein-before contained he would have been entitled to deduct from his rent had he paid to the commissioners as aforesaid the sum so deducted from the rent payable to him; and the receipt of the commissioners, or of their treasurer or clerk, duly authorized in that behalf, shall be in each case a sufficient discharge for so much of the rent as is hereby authorized to be deducted: provided always, that nothing herein contained shall be taken to affect any special contract between any lessor and tenant or occupier of any lands or tenements, whereby it is agreed that the tenant or occupier shall defray the charges of making, repairing, or cleansing all or any sewers, drains, cesspools, and privies belonging thereunto.

40. And be it enacted, that the limits of this act in England shall be the city of London; every place within six miles in a straight line from St. Paul, and also within the jurisdiction of any commission of sewers now in force for any part of the counties of Middlesex or Surrey, during the continuance of such commission; and also every place in England within the jurisdiction of any commission of sewers which shall be duly issued after the passing of this act, by letters patent, wherein it shall be expressly declared that such commission is issued in furtherance of the provisions of this act.

41. After the passing of this act it shall be lawful for her Majesty, &c., to issue commissions of sewers in furtherance of this act for any part of Ireland.

42. And be it enacted, that this act shall extend to Scotland, and shall include all royal and parliamentary burghs, burghs of barony and regality, and also all towns and villages in Scotland which her Majesty with the advice of her privy council shall from time to time order to be within the provisions of this act.

IMPROVEMENT OF BOROUGHS.

There is a Bill now before the House of Commons intituled "an Act for the improvement of certain Boroughs," which act is to grant powers for opening and widening close and narrow streets, alleys, passages and places therein, and for otherwise improving the town, such powers to be vested in the councils of such boroughs, under certain restrictions. The following clause is the most important, and explains when the council is empowered to take lands compulsory.

4. And be it enacted, that in any of the following cases the council shall be empowered, if they think fit, to take any lands which they shall require for the purposes of this act, with or without the consent of the several owners and other persons interested therein, subject nevertheless to the provisions for ascertaining and giving compensation for the value of such lands, and for the other purposes herein-after contained; (that is to say,)

1. When any such lands are needed for the purpose of opening a thoroughfare through any court or alley which is closed at either end:
2. When any such lands are needed for the purpose of widening any thoroughfare which is narrower than 20 feet:
3. When any such lands project 10 feet or more beyond the general line of the street:
4. When the council shall have agreed with the owners thereof for the absolute purchase of the lands on each side of the lands so required to be taken, the value of those already agreed for being at least 10 times the value of those not agreed for:
5. When any such messuages or tenements built before the passing of this act are contrary to the provisions of an act passed in this session of parliament, intituled "an Act for regulating Buildings in large Towns and Villages," and are not amended according to the provisions of the said act within six calendar months after notice thereof given by the council to the owner or occupier thereof:

Provided always, that it shall not be lawful for the council to take any such messuages, lands, or tenements, without the consent of the owners and other persons interested therein, unless with the approval of the commissioners of her Majesty's woods, forests, land revenues, works, and buildings.

NEW HOUSES OF PARLIAMENT.—VENTILATION, &c.

The following is a copy of the correspondence for the warming and ventilation of the two Houses of Parliament, laid before Parliament.

Office of Woods, Aug. 27, 1841.

Sir—The progress of the works at the new Houses of Parliament, and the necessity of laying down the foundations on which the flues for warming and ventilating the houses are constructed, induced me to desire Mr. Barry and Dr. Reid to make a joint report on these subjects, by which it appears that a sum of 86,000*l.* will be required for warming, ventilating, and securing the buildings from fire, according to the following statement:—

Ventilating tower		£20,000
Air and chimney flues in the walls		12,320
Apparatus		12,000
		£44,320
For securing the buildings from fire—		
Fire-proof floors under the roof	£20,680	
Brick floor on iron beams between the principal and upper stories	21,000	
		41,680
		£86,000

I must observe, that in this sum Mr. Barry has included the sum of 20,000*l.* for a centre tower, not intended in the original plan, but which will be so constructed as to suit Dr. Reid's new system of ventilation, which he considers will be a great addition to the beauty of the structure. I am unwilling to recommend so large a sum to the Treasury without the sanction of Parliament, although a considerable part will be necessary under any circumstances, if the houses are to be warmed and ventilated on the system adopted by Dr. Reid in the present temporary houses, and which appears to me to give general satisfaction.

From the prices at which contracts have been taken for the works already in progress, there can be no doubt, with care and attention, that a considerable saving will take place on the original estimate that was sanctioned by the committee of the two houses; and I therefore request you to bring the subject before the House of Commons, as the state of the works makes it necessary that some decision should be come to without delay; I will only add, that no unnecessary delay has taken place in bringing this subject forward, and that Dr. Reid has delivered in his estimate as soon as the state of the works allowed him to do so.

I have, &c.,

Duncannon.

The Right Hon. F. T. Baring, &c.

Westminster, Aug. 21, 1841.

My Lord—I beg to submit for your Lordship's consideration, a drawing of the river front of the new Houses of Parliament, showing the effect of a central tower of the height and diameter required by Dr. Reid for the purpose of ventilation, according to his first suggestion; and I have no hesitation in expressing my opinion, that the adoption of such a feature in the design would considerably improve the general effect and importance of the intended building.

I have, &c.,

The Viscount Duncannon. Charles Barry.

Whitehall Treasury Chambers, Sept. 14, 1841. T. F. Fremantle.

PROFESSIONAL CHARGES.

Vignolles *v.* Lefroy.

At the last Summer Assizes held at Liverpool, August 30, the following important action was tried against the Hon. Thomas Lefroy, M.P., as one of the directors of the Central Irish Railway Company, to recover compensation for work and labour performed by the plaintiff as an engineer.

Mr. Dundas, Mr. Martin, and Mr. Watson were for the plaintiff; Mr. Cresswell, Mr. Wortley, and Mr. Cleersby for the defendant.

The details of the case were long and tedious, but the following were the principal facts:—

It appeared in the case for the plaintiff, that, in the year 1836 a number of gentlemen, connected with Ireland, were of opinion that a railway from Dublin to Sligo, running through the centre of the island, would be a desirable undertaking. Of these, the defendant was one of the most active. Preliminary meetings were held, prospectuses issued, the usual staff appointed, and other measures taken for carrying the project into execution. A provisional committee was formed, at whose meetings the defendant usually assisted, and very frequently took the chair. The meetings took place, whether in London or Dublin, usually at the offices of Messrs. Young, Murdoch, and Leahy, solicitors to the company. The services of an engineer being required, some discussion took place on the appointment. A person of the name of Walker was mentioned, but it was afterwards decided, very much at the instance of the defendant, that the plaintiff, who had been the engineer of the North Union, the Midland Counties, and the Dublin and Kingstown Railways, should be requested to undertake the office. The solicitors for the company communicated with him, and he accepted the situation on the 4th of June. Immediate steps were taken for completing a survey, and a number of Mr. Vignolles's pupils and assistants were set to work upon the line. He himself paid frequent visits to Ireland in superintendence of the work up to the 21st of September, during which time frequent meetings of the committee had taken place in London and Dublin, at which the defendant presided, and on which occasions resolutions were come to as to the course which should be adopted, and the measures which should be taken in advancement of the project. One subject of discussion was, the site for the Dublin terminus, and on this point some correspondence took place between the plaintiff and the defendant with reference to a meeting to discuss the matter in Dublin, and the course which should be adopted respecting it. In one of these letters the defendant says, that the terminus at Kilmainham would not go down with the Dublin people, and that he must rely upon the skill and industry of Mr. Vignolles to select a better one. On the 21st of September a meeting of the committee took place, at which the possible appointment of Mr. Vignolles to the office of engineer to the Irish Railway Commission was brought under their notice, and it was agreed that his name should cease to appear as the engineer to the company, being replaced by a Mr. Nimmo, one of his assistants, who had previously been carrying on the survey under his superintendence. It was, however, for the plaintiff, alleged that he continued really to superintend the work as before, and that Mr. Nimmo was acting under him, and not as an independent engineer. The plaintiff went to Ireland repeatedly, and carried on a correspondence with Mr. Nimmo when in England. The work was then completed, the surveys made, and the necessary maps and books of reference deposited in the Parliamentary offices. Mr. Nimmo died in 1839. The present action was brought by Mr. Vignolles for the balance due to him for these engineering services. He had received 500*l.* His charge was 40*l.* per mile on a line of 126 miles. Much more, it was said, had been surveyed, including the lines which had been abandoned as not eligible.

For the defendant it was contended that there was no contract between him and the plaintiff, and that though, as a public man and a member of Parliament, he had encouraged a project which it was supposed would be of public benefit, he was not himself one of those embarked in the speculation, had never taken or been allotted any shares, and had merely given the provisional committee his assistance and advice. It was alleged that at all events the plaintiff had resigned his office of engineer in September, when appointed to the Royal commission; and that, even supposing he had executed all the work, the charge of 40*l.* per mile was excessive. Considerable payments had been made to Mr. Nimmo.

The case occupied the whole day, and at nearly 8 o'clock the Court adjourned, postponing his Lordship's summing up until the following day, when his Lordship having gone through the facts of the case,

The Jury retired for a considerable time, and brought in a verdict for the plaintiff—Damages 1,980*l.*, being the balance due up to September 21, when they were of opinion he ceased to be engineer to the company.

Exportation of Machinery.—The select committee of the House of Commons, lately appointed to inquire into the operation of the existing laws affecting the exportation of machinery, have just published their second report to the House. This report is much too long to allow of any detailed reference to it, but we subjoin the final recommendation of the committee on the subject, which is to the following effect, viz.:—"That, considering that machinery is the only product of British industry upon the export of which restraints are placed, the committee recommend that the law prohibiting the export of machinery should be repealed, and the trade of machine making be placed upon the same footing as other departments of British industry."

STIRLING'S AIR ENGINE.

Messrs. Stirling have constructed an air-engine, now working at the Dundee Foundry, which fully realizes the expectations of the inventors: its superiority over the steam engine consists in an immense saving of fuel, and in its capability of being contained in a very small space. For the purposes of navigation these properties are invaluable. We subjoin a description of the air-engine, furnished us by a friend well acquainted with mechanics.

The air-engine now working at the Dundee Foundry, for which a patent was lately taken out, is the joint invention of the Reverend Dr. Stirling, of Galston, and of his brother, Mr. Stirling, engineer, Dundee.

The principle of the invention consists in alternately heating and cooling two bodies of air confined in two separate vessels, which are arranged so, that, by the stroke of two plungers worked by the engine, while the whole of the air contained in one of the vessels is at the lower end immediately over the furnace, and is consequently quite hot; the whole of the air contained in the other vessel is at that time disposed at the upper end, which is cut off from any communication with the furnace, and is therefore comparatively cold.

The expansion caused by the heat renders the air in the one vessel much more elastic than that in the other; and the two ends of the working cylinder, which is fitted with a piston similar to that of a steam-engine, being respectively connected with the two air-vessels; a preponderating pressure is produced on one side of the piston, and it is thereby pushed to the opposite end of the cylinder. By the alternate action of the plungers in the two air-vessels, this end of the cylinder then comes in its turn to be subjected to the pressure, and the piston is thereby pushed back again to its former position, and so it continues a reciprocating motion, and is applied to turn a crank in the same way that a steam engine does.

It has been satisfactorily shown that this engine may be worked with very great economy of fuel as compared with a steam engine; and the principal means of producing the saving is this; that, of the heat which is communicated to the air from the furnaces, only a very small portion is entirely thrown away when the air comes again to be cooled; for, by making the air, in its way from the hot to the cold end of the air-vessel, to pass through a chamber divided into a number of small apertures or passages, the great extent of surface with which it is thereby brought in contact, extracts in the first place, but only temporarily, the greater part of the heat from the air; and afterwards restores it to the air on its passage back again from the cold to the hot end of the vessel. The process of cooling is finally completed by making the air to pass through between a number of tubes in which there is a current of cold water, and thus far the heat cannot be made available again, but the portion which is abstracted in this way is very small.

As a sufficient expansive power could not be attained from using air of the common density of the atmosphere; without either making the diameter of the cylinder, and all the other parts of the engine inordinately large, or subjecting the air to greater alternations of heat and cold than would be convenient; the air is used pretty highly compressed, and a much greater power is thereby obtained upon a given area of the piston.

It is necessary therefore to employ a small air-pump to keep up the air to the requisite density: but very little power is expended on this; for, as the same body of air is used over and over again, all that is required of the air-pump, after the engine has been once charged, is to supply any loss that may arise from leakage; and this is found to be very trifling.

The machine has been working occasionally for about six months, and it has been proved, to the satisfaction of the inventors, to be capable of performing advantageously the amount of work which they had reckoned on, from their calculations, and from former experiments made on a working model of about two horses' power. It has now, for upwards of a month, been doing work in driving all the machinery employed at the extensive engineering works of the Dundee Foundry, which a steam engine of approved construction had hitherto been employed to do; and it has been ascertained that the expenditure of fuel is, *ceteris paribus*, only about one-fifth part of what was required for the steam engine; but, as considerable improvements are contemplated in some of the details, it is confidently expected that a much greater saving of fuel eventually will be effected.

The whole machine, including its furnaces and heating apparatus, stands in about the same space that a steam engine of equal power would occupy without its furnaces and boiler; and, taking into account this saving of space, along with the vast saving of fuel, the invention must necessarily be of immense importance for all ordinary purposes requiring motive power; and, as an instance, it would reduce the expense of the power employed in driving machinery in Dundee alone by at least 25,000*l.* or 30,000*l.* a year; but, viewed in reference to the purposes of navigation, the application of this invention must lead to results still more extraordinary, and will render a voyage to India round the Cape, by machinery, a matter of perfectly easy accomplishment.—*Dundee Advertiser.*

Herculaneum—It is stated that the Neapolitan government have resolved upon undertaking some new excavations at Herculaneum and its neighbourhood, and it is added that they will be on an extensive scale. Negotiations have commenced already with this view for the purchase of various estates on the spot; and so soon as these purchases have been completed the works will be commenced. A commission of antiquaries and architects is to be appointed by the Minister of the Interior and the Royal Academy of Sciences to preside over the operations of the workmen; and no doubt discoveries will be made to add largely to the present knowledge of this interesting ruined city, and the manners and customs of its former inhabitants.

THE ZINKING PROCESS.

We derive from the *Revue Generale de l'Architecture* the materials for the following notes on the process of zinking iron, as described by the Baron Menu de Mesnil, in the Report of the Committee of Inquiry to the Minister of Marine in France. On the importance of preserving iron from oxydation it is unnecessary to make any remark, we may just observe that the only effective modes hitherto used have been tinning and glazing. In 1742 M. Maloin presented to the Royal Academy of Sciences a memoir on the analogy which he had observed between iron and tin, and points out a mode of zinking iron similar to the modern one. Whether the price of zinc was then too high or other difficulties stood in the way, it was not until 1836, that the process of zinking was made effective by M. Sorel, who took out a patent for it under the name of Galvanization of Iron. On the 28th September 1838, a committee was named by the Minister of Marine to make experiments in the dockyard at Brest on zinking iron, by them a first report was made recommending experiments to be made on a larger scale, which latter commenced on the 14th of May 1840, and it was on the 30th April of the present year that they made their report.

The process consists simply in dipping an iron article, previously cleaned with acid, for 3 or 4 minutes into zinc infusion, then taking it out progressively, shaking it in the air to get rid of the excess of zinc, and at last plunging it suddenly in cold water; after which it only requires to be rubbed over with fine sand and dried. What is called Galvanization is therefore nothing more than a process similar to tinning; but while iron is rendered more oxydable by contact with tin, and oxidizes rapidly, if by any mistake in the preparation the iron is left uncovered in any point; in zinking, on the contrary, a true alloy of zinc is formed on the surface of the iron, and the parts accidentally left unzinked alone rust, and the evil is soon stopped. This latter fact is enough to prove that the iron is not protected by any Galvanic effect as is the opinion generally received. Thus in the operations preparatory to zinking, such as cleaning by acid, &c., great care is taken to free the surface of the iron by scraping from it all matters which would resist the action of the acid, and prevent zinc from attaching to the iron all over.

The cleaning with acid is an operation which requires much care, for while it is indispensable that the iron subjected to the acid should be wholly free from rust, care must also be had that the iron be not too strongly acted upon by the acid, but be taken out at the proper moment. Very weak acids only are used for the cleaning as a mixture of nine parts of sulphuric acid with 100 of water. In France the refuse acid used in purifying vegetable oils is also employed; after a certain time the acid can no longer be used, as it is almost wholly turned into sulphate of iron, a salt which may be readily extracted, and which would bring more than the worth of the acid used. The time during which the iron is kept in the acid varies according to the degree of rust from 12 to 24 hours.

The pieces after coming out of the acid bath are cleaned and passed rapidly into hydrochloric acid of 15°, and then put in a stove to be quite dried. It is in this state of absolute dryness that they may be plunged into the zinc infusion. At the time of immersion the object is powdered over with sal-ammoniac, a great part of which volatilizes, and then decomposes, and the remainder, the acting portion, cleanses the object a third time, and makes the zinking certain and perfect. The use of this salt, on account of its value and the large quantity used, forms a great part of the cost of zinking. The zinc bath soon becomes covered with a black fluid matter, without adherence to the surface of the bath, on which it forms a continuous layer. The workmen consider it as advantageous to the zinking, and therefore take it out of the bath after the day's work, and put it in again the next morning, when they go back to work. During the night the zinc it kept in fusion, and the surface exposed to the air, is tarnished and oxydized, and it may be therefore allowed that the black matter acts so as to dissolve the oxide formed, and thus to restore the surface of the zinc to the purity requisite for zincing properly. An analysis of this black matter, made at Brest by M. Langonné, First Class Naval Apothecary and Member of the Committee, shows it to be composed of a great quantity of chlorure of zinc, a small portion of chlorure of iron, and an insoluble compound of ammoniac and zinc. As we know therefore that chlorure of zinc and ammoniac are good detersives, it is not surprising that the black matter, having an analogous composition, should be equally efficacious. The time that objects remain in the zinc bath depends on the dimension, if they are thin, they must be only rapidly passed through, if massive they must be left some minutes. In general it is enough to take the objects out as soon as they leave off giving out smoke or rather steam.

The immersion of the zinked object, still quite hot, in cold water, is for the purpose of preventing the formation of oxide of zinc, which tarnishes the surface, but this operation gives the iron a kind of tempering, which added to the effect of a layer of alloy covering the surface, renders it more brittle. Sheet iron in particular, on account of its thinness, is subject to this inconvenience, and can no longer be bent with ease. An improvement has however been recently made, which avoids the dipping, the slight layer of oxide of zinc which is formed on the surface, and which does not stick, is easily got rid off by rubbing after the object has been cooled in sawdust and sand.

When objects have just been zinked, they have a metallic lustre, which they will keep for a long time, when free from damp, but when left in the air they by little and little tarnish, become covered with a whitish efflorescence, which increases, acquires consistency, sticks to the metal, and soon forms a continuous and solid layer, which preserves the surface from ulterior alteration. This transformation is slow in taking effect, and appears to be complete only after 15 or 18 months' exposure to the air. Even the weakest acids and the alkalis attack and dissolve the zinc with the greatest facility and bare the iron. Heated red for several minutes the layer of zinc in excess soon peels off, but the iron is not yet bared, as the alloy of zinc and iron, more adherent, harder, and less fusible, long repel the action of heat.

The thickness of the zinc layer is very small; on cannon balls it was only 16 hundredths of a millimeter, on sheet iron it was from 7 to 12 thousandths of a millimeter, 9 thousandths is the mean. The thickness has little effect on the windage of cannon balls, but the committee suggest that zinking might be employed to increase the diameter of deficient balls. The committee farther suggest that experiments should be made to zinc old iron objects in order to preserve them. The thickness of the layer of zinc, although so very small, is amply sufficient, when we consider that an alloy is formed with the iron, which extends its protective influence deeper into the metal.

The influence of the air or water is very little on the zinked iron, if entirely exposed, but if subjected to the action of water and air alternately, they are more affected. Zinked apparatus produces no injurious effect upon drinkable water.

As to the various articles on which they experimented the committee report that the zinking appears very effective for roofs and cisterns. Zinked nails and bolts are recommended for shipping, but the committee are not yet prepared to recommend them to supersede copper. These nails are recommended for the decks of ships, as the ordinary nails soon produce a black spot on the surface of the wood, which penetrates and affects the fibres, gallate of iron being produced. Zinked nails are strongly urged as substitutes for iron in securing slates on roofs, as the iron nails soon rust, particularly near the sea, and in high winds are the chief cause of the slates falling. The zinked gutters the Committee consider will supersede tin. For the flues of stoves the zinked iron is recommended, and zinked wire also meets with their approbation. They had not made sufficient experiments as to chains, but they reported that those which they had tried, when put to the hydraulic test, supported it well. For locks and bolts in lighthouses and sea buildings, zinking is exclusively advocated. An advantage which zinc possesses for ear-rings for sails is that it does not rust the sails, which is apt to rot them.

The Committee conclude by making several recommendations. They report that zinking of wrought and cast iron can easily be practised in all ordinary circumstances of the use of that metal, that zinking shows every symptom of durability, and that it is of the greatest advantage to the navy. They consequently recommend a contract to be made with the patentee for the use of zinc in the arsenals of France, being convinced of its efficacy.

S. L. AND CANDIDUS.

The question at issue between S. L. and myself seems as it were about to be protracted as interminably as a Chancery suit. However we now seem to understand each other somewhat more clearly than at first:—at least there is one point on which he expresses himself decidedly, and on which I can cordially agree with him; since so far from attempting to defend, he unscrupulously reprobates that sickly soidisant *Greekism*, and pseudo-classical style, which during the last thirty years have given us so many "insipid abortions," where opportunities—now, alas! not to be recovered—presented themselves for achieving noble and original works.

Most certainly S. L. is not mistaken, when he imagines I will admit that Grecian and Roman architecture affords resources not yet worked out, ideas so capable of being yet further extended, that they may be said to be as yet only very partially developed, whereas they have

only been studied and cramped in the mechanical productions of the school. My chief surprise is that he should for a moment doubt or affect to doubt my sentiments on that head, when I have more than once plainly stated—though perhaps in the very same terms I now use—that I am not an admirer of any one style in particular, however excellent it may be, to the exclusion of all others. My architectural creed is of a more liberal and comprehensive kind: it is free from those narrow sectarian prejudices that blind some to all beauty—all merit that does not come under the standard of their favourite style. So very far am I from being one of those who can not only tolerate, but admire even inferior productions, provided they do but belong—if only nominally—to what they consider the only legitimate mode, that as far as æsthetic value is concerned, I hold the manner in which a style is treated to be even of more importance than the question of style itself. So long as the work itself manifests artistic spirit, feeling and power, the particular language of the art, it happens to be composed in, is comparatively of little or no moment, however important it may be from other considerations attending any given case;—so far at least adopting Pope's doctrine that

"Whate'er is best administered is best."

By no means, was it my intention in what I first said to uphold the Gothic in preference to all other styles, nor did I conceive that it would be so construed by any one. And having thus cleared up S. L.'s misconceptions—or at least his doubts, I may now leave him to call Welby Pugin to account, as being a far greater offender—not only a staunch advocate for Gothic, but so exceedingly intolerant withal, that he would, were it in his power, exclude and uproot every thing else. Yet, should he have read the Professor's "True Principles," S. L. will probably not care to measure his strength with so redoubtable a champion. In case they should ever so encounter each other in argument, they may probably be so well matched that each will make a convert,—as such things have happened before now, and that S. L. will be converted to Puginism, while Pugin goes over to "Paganism."

Candidus.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

April 6.—The President in the Chair.

Experiments on the strength of Iron Girders. By Thomas Cubitt, Assoc. Inst. C. E.

This communication gives in a tabular form the results of experiments upon upwards of 60 pairs of cast iron girders, varying in length between 7 ft. 6 in. and 27 feet, with corresponding depths, and of all the forms usually adopted for beams for buildings. They were proved in pairs by a hydraulic press placed between them, the ends being retained by wrought iron ties. The deflexion was noted at each increase of pressure, and in many instances the beams were fractured.

Sketches of the girders, and of the apparatus used for proving them, accompanied the paper; from them five drawings have been made at the Institution to facilitate a reference to the information contained in the communication.

Description of an improved Level and Stand. By G. Townsend.

This improvement being intended to procure a firmer basis and greater facility of adjustment than by the ordinary level, the author has adopted the principle of the triangular plate, with three levelling screws. In the ordinary instrument, with two pairs of screws, it has been found that the antagonist screws, besides being apt to wear unequally, and to indent the lower plate, are sometimes bent, and thus cause an unequal action upon the upper plate. To obviate these defects, the screws in the tripod level are made to work into inverted cones, which are fixed in the three grooved arms of the stand head; the weight is more equally distributed, and the telescope more speedily brought to a level.

The telescope is fixed to the levelling plate by an upright limb, and to this is added a small longitudinal cross level, as in Gravatt's instrument. In the improved stand, each of the legs is attached to two arms of the lower tripod plate, by which means a firmer basis is obtained. The usual locking plate, to secure the levelling screws, is also attached to this instrument, and kept in place by a spring catch; there is also a metal ring fixed on the upright limb, above the arms, and which falls into three spring catches in the table plate, by which any derangement from accidental violence, or in removal from one station to another, is effectually prevented.

A small circular spirit level is fixed in the stand in order to adjust it before the instrument be placed on it, by which means the labour of adjustment is considerably abridged.

April 20.—The President in the Chair.

Experiments for determining the position of the Neutral Axis of rectangular beams of Cast and Wrought Iron and Wood, and also for ascertaining the relative amount of compression and extension at their upper and under surfaces, when subjected to transverse strain. By Joseph Colthurst.

These experiments were undertaken in consequence of the difference of opinion which has long existed respecting the position of the neutral axis of extension and compression of iron and wood.

First experiment.—Two series of experiments were made to determine this point by cutting through the centre of each of a set of eight girders, each 6 ft. 6 in. long, 5 in. deep, and half inch thick, the first to the depth of half an inch, the second to the depth of 1 inch, and so on, to the eighth girder, in which only 1 inch of metal remained unsevered. The spaces cut out were then filled with carefully fitted wrought iron keys, and the girders were broken by the application of weights, in the expectation that these weights would be some indication of the neutral point of each girder. The results were, however, so irregular, that no satisfactory deductions could be drawn from them.

Second experiment.—The next attempt was made in the manner suggested by the late Mr. Tredgold, by drawing two fine lines, 2⅘ inches apart, on a polished surface at right angles to a girder, in the middle of its length; it was then subjected to strain, and dimensions were sought to be taken to determine where their divergence and convergence commenced, but the differences were too small to be susceptible of accurate determination, otherwise than by a fine micrometrical operation, which at the time the author had not an opportunity of applying. The following plan was therefore adopted.

Third experiment.—In the side of a cast-iron girder, 6 ft. 6 in. long, 7 in. deep, and 1 inch thick, a recess was planed at the centre, 3 in. wide by ¼ in. deep. This was filed up very true, and fourteen small bars of wrought iron, with conical ends, were placed in it at regular distances of ½ an inch apart. These bars were of such lengths as to hold sufficiently tight to carry their own weight, and yet that the slightest touch should detach them. The girder was then subjected to strain. The supports were 6 feet apart; with a strain equal to 100 lb. the lower bar fell out; as it was increased, they continued to drop, and with 1500 lb. all those below the centre had fallen. The strain was then increased to 7000 lb., but no more bars fell. The centre bar remained exactly as when put in; all those above the centre became firmly fixed, and were evidently under considerable compressive force. The strain was then gradually taken off, and all the bars above the centre fell out, their ends having become compressed by the sides of the recess pressing on them; they were of course too short when the girder resumed its former condition, and the recess its previous width. These experiments were repeated several times, with pieces of fine wire and dry lance-wood charred at the ends.

The result in every case showed that the *neutral axis* of extension and compression was certainly situated within $\frac{1}{10}$ of an inch of the centre.

Another experiment was still more decisive. A girder 9 ft. 6 in. long, 8 in. deep, 1 in. thick, was cast with two brackets or projections on the side, each 9 in. on either side of the centre. A brass tube bar, with circular ends and a sliding adjustment, was fixed between the brackets, which had been filed true. The clear bearing was 7 ft. 6 in.; a strain of 50 lb. was sufficient to cause this bar to drop out; and with 250 lb. the whole effect of the previous experiment was produced. The tube, when placed loosely, 1 inch above the centre, was held fast by a strain of 1000 lb.

Wrought Iron.—Similar experiments were then made on wrought iron, with precisely the same results, showing that the neutral axis, if not actually situated at the centre, was nearly identical with it.

Wood.—A similar series of experiments, made upon wood beams, gave exactly the same results as regarded the position of the neutral axis.

From all the foregoing experiments, the author concludes that the neutral axis of extension and compression in rectangular beams of cast and wrought iron and wood, is situated at the centre of their depth, when those beams are subjected to transverse strains.

Extension and compression. Cast Iron.—Experiments were also instituted to ascertain the amount of extension and compression of cast and wrought iron and wood.

Upon a bar of cast iron, 3 inches square, and 9 feet long, two strips of thin hoop iron were attached, the one on the upper, and the other on the lower side, each strip being fastened to the bar at one end only, while the other end was left free; any change which occurred in the length of the surface to which it was applied was clearly indicated. The differences were recorded by very fine lines on a polished surface. The strips were 7 ft. 6 in. long, and were bound to the whole length of the beam by bands of fine wire, wound round and enclosing them at every 9 inches; the beam was then subjected to strain, and the following results were obtained:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
1000	0·22	..	..
2000	0·45	0·04½	·04½
3000	0·65	0·06	0·06
4000	0·87	0·08	0·08
5000	1·20	0·11	0·12
6000	1·50	0·13	0·14

6240 the beam broke; good iron, showing a good clear fracture.

It will be perceived, that until rather more than two-thirds of the breaking weight was put on, the amounts of extension and compression did not sen-

sibly differ, but between that point and the breaking weight, extension yielded in a higher ratio than compression.

Wrought Iron.—Similar experiments were next made on bars of wrought iron, 2½ in. square; the supports were 13 ft. 6 in. apart, and the strips of oop iron were 12 feet long.

Weight. lbs.	Deflection. inches.	Compression. inches.	Extension. inches.	Elasticity impaired.
500	0·55	0·03	0·03	..
1000	1·55	0·06	0·06	..
1280	1·45	0·07	0·07	0·15
1560	1·85	0·08	0·08	..
1800	2·20	0·09	0·09	..
2000	2·70	0·11	0·11	0·65
2280	4·15	0·18	0·19	2·05

With this weight the beam was permanently bent, and its elasticity nearly estroyed.

These experiments showed that, differing from cast iron, the amounts of extension nd compression in wrought iron continue to be equal up to the complete destruction of the elasticity of the beam.

Fir battens.—The amounts of extension and compression in rectangular beams of fir timber, when subjected to transverse strain, were next determined; the manner of proceeding was precisely the same as in the preceding experiments.

A batten, 4 in. by 3 in., with the supports 8 ft. 2 in. apart, and with strips 7 ft. 6 in. long, when subjected to transverse strain, gave these results :—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
500	1·10	0·12	0·12
1000	2·30	0·24	0·24

Results.—From these experiments on the amount of extension and compression of cast iron, measured at the under and upper surfaces of rectangular beams, subjected to transverse strain, the author assumes, that within limits which considerably exceed those of elasticity, and equal to at least two-thirds of the breaking weight, there is no sensible difference between the amounts of compression and extension, and that as the breaking point is approached, extension yields in a higher ratio than compression, and gives way first.

It would appear certain that up to the point when the elasticity of wrought iron is completely destroyed, and the beam is bent, the amounts of compression and extension continue exactly equal, and it is therefore probable that this equality would continue to the last.

It is clear that the amounts of extension and compression up to three-fourths af the breaking weight do not sensibly differ in fir battens, but that as the ultimate strength of the beam is approached, compression yields in a much higher ratio than extension, and may be actually seen to give way first.

He states also, that the amounts of extension and compression are in direct proportion to the strain, within the limits of elasticity, and that even after those limits are greatly exceeded, and up to three-fourths of the strength of a beam, they do not sensibly differ.

The apparatus with which these experiments were made was exhibited, and presented by the author to the Institution.

Mr. Donkin eulogised the novel and ingenious manner in which Mr. Colthurst had conducted the experiments, which he considered to be highly satisfactory. They not only determined the position of the neutral axis of the beams experimented upon, but showed also the relative amounts of compression and extension, so as to demonstrate that the elasticity of a body was the same in compression as in extension. These experiments also confirmed the correctness of Tredgold's opinion as to the pernicious effects of attempting to produce peculiar forms in beams by cambering and inserting wedges into their upper sides.

Mr. Vignoles reminded the meeting of the discussions which had taken place relative to the position of the neutral axis in the railway bars, which had the upper and under tables similar; it was contended that the neutral axis was situated close beneath the upper lip, or table of the rail, whereas, if Mr. Colthurst's mode of experimenting had been adopted, a different and more correct result would have been arrived at.

Mr. Cubitt accorded great merit to Mr. Colthurst for the experiments, which had determined the question as regarded rectangular beams. It appeared that no attempt had been made to use the same mode of proceeding with beams of irregular figures; in them, therefore, it might be concluded, that the neutral axis would be found in the centre of gravity of the section of the beam.

Mr. J. Horne remarked, that these experiments perfectly accorded with those which he laid before the Institution in 1837. His object had been to show that the neutral axis was always in the centre of gravity of the section, as well as to determine the figure which should resist the greatest amount of pressure with a given quantity of materials; the strongest form was shown to be a prism, placed with the base upwards, and the same figure reversed was the weakest; the strength of the former figure exceeded that of the latter by at least one-third.

April 27.—The President in the Chair.

Memoir of the Montrose Suspension Bridge. By J. M. Rendel, M. Inst. C. E.

Previous to the year 1792, the passage of the River Esk at Montrose was effected by common ferry boats; at that period an act of parliament was obtained for the construction of a wooden bridge, with numerous arches, or rather openings formed by beams, supported upon piles, with stone abutments at either end; the action of the tide undermining the piles, and the usual progress of decay causing great expense for repairs, it was decided in the year 1825, to erect a suspension bridge, the iron work of which was contracted for by Captain Samuel Brown, R.N., for the sum of £9,430, and the masonry of the towers for £9,080. The total cost being £18,510, exclusive of the land arches and approaches; those of the old bridge being preserved for the new one.

The dimensions of the new bridge were—

	Feet.
Distance from centre to centre of the towers	432
Deflection of the chain or versed sine of the catenary	42
Length of the suspended roadway	412
Width of ditto	26
Height of ditto above low water	21
Ditto of the towers above ditto	68
Base of the towers at the level of the roadway	40 by 20
Archways through the towers	16 wide, 24 high

The towers were built of red sandstone ashlar, raised on a base of the same material, carried upon piles.

Construction.—There were two main chains on each side, arranged above each other in parallel curves, 12 inches apart. Each chain was composed of four bars of iron, 5 inches wide by 1 inch thick, and 10 feet long, united by short plates, and strong wrought iron pins. The roadway was suspended to these chains by perpendicular rods, 1¼ inch in diameter, attached at intervals of 5 feet, alternately to the upper and lower lines of main chains, at the joints, which were arranged so that those of the upper chain should be over the long bars of the lower one; at the lower end of each suspending rod was a stirrup, which received and carried the cast-iron bearers for supporting the roadway.

Upon these bearers was laid and rivetted longitudinally a flooring of fir planks, 3 inches thick, and well caulked; upon this a sheathing of fir, 1½ in. thick, was placed transversely, and spiked to the lower planks; over all was spread a coating of about 1 inch thick of fine gravel and sand, cemented with coal tar.

The suspending rods were without joints. The main chains rested upon detached cast iron saddles, built into the masonry of the towers, and passing down at either extremity, were secured behind cast iron plates in masses of masonry, 10 feet under ground.

The construction was commenced in September, 1828, and was finished in December, 1829, a period of only sixteen months.

Accident to the Bridge.—On the 19th of March, 1830, about 700 persons assembled on the bridge to witness a boat race, when one of the main chains gave way, and caused considerable loss of life. The injury was speedily repaired, but a careful survey of the structure was ordered, and it was discovered that the intermediate or long links of the chains bore so unequally upon the saddles as to be bent and partially fractured. Mr. Telford, who was consulted on the subject, proposed the addition of two other main chains placed above the original ones, and having the same curve, so as to increase the sectional area 40 inches—thus giving six chains of 20 inches area each, instead of four chains, as originally constructed.

Mr. Telford's decease occurring at that period, the author was instructed to report upon the state of the bridge, and advise such alterations as he judged to be necessary.

After a minute personal inspection he concurred in Mr. Telford's idea of the necessity of increasing the strength of the bridge, but instead of augmenting the number of the chains, he advised the addition of two bars in width to each of those existing, by which means the required strength might be gained. He was led to this by an opinion that, in all cases, it is desirable to have as few chains as possible.

It appeared that there had been but little precision in the workmanship of the chains; for on releasing them they immediately became twisted; thus showing that all the links had not a true bearing. On taking them apart, many of the traversing pins were found to be bent, and some of them were cut into, evidently by the friction of the links. This was to be rectified, and new saddles of a different principle and stronger form were recommended: also, that those parts of the chains which rested in the saddles should be entirely composed of short plates. Additions to the masses of masonry holding the chains were likewise deemed advisable.

Between the years 1835 and 1838, all the principal works, with many minor improvements, were executed.

In the author's report on the state of the bridge, he noticed what he deemed defects in the construction of the roadway, but as there was no positive symptom of failure, it was allowed to remain. He conceived, that in the anxiety to obtain a light roadway, mathematicians and even practical engineers had overlooked the fact, that when lightness induced flexibility, and consequently motion, the force of momentum was brought into action, and its amount defied calculation.

On the 11th of October, 1838, the roadway of the bridge was destroyed by a hurricane, the effect of which upon this structure is the subject of a paper by Colonel Pasley, published in part 3, vol. 3, of the Transactions of the Institution C. E. To that account the author refers for the principal details, only adding, that on inspecting the bridge, he found the chains, the saddles, and the fastenings or moorings, quite sound; the principal portion

of the roadway had been completely carried away, and the remainder much injured. He then gives some account of the undulatory motion observed during the storm. This motion was greatest at about midway between the towers and the centre of the roadway; but the waves of the platform did not coincide with those of the chains, either in magnitude or in order; no oscillatory motion was perceived either in the roadway or in the chains, although particular attention was directed to them.

It appears that the centre of the platform fell in a mass. This the author attributes to the failure of the suspension rods, which, having no joints, were twisted off close to the floor by the undulatory motion. A similar occurrence at the Menai Bridge* induced Mr. Provis to adopt the joints in the suspension rods, which the author had previously introduced at the Montrose Bridge.

The author had long been convinced of the importance of giving to the roadways of suspension bridges the greatest possible amount of stiffness, in such a manner as to distribute the load or the effect of any violent action over a considerable extent.

The platforms of large bridges, in exposed situations, are acted upon in so many different ways by the wind, that he had an objection to the use of stays or braces to counteract movements which ought rather to be resisted by the form of the structure.

Holding such opinions, he determined to adopt a framing which, although connectedly rigid in every direction, should nevertheless be simple, composed of few parts, capable of being easily renewed; should distribute its weight uniformly over the chains, not be subject to change from variation of temperature, and not augment the usual weight of suspended platforms.

The details of the alterations, and general repair of the bridge, are then given; a few may be mentioned.

An entirely new set of stronger suspending rods was introduced; they were 1⅛ of an inch in diameter down to the flexible joint at the level of the platform; below that point the diameter was increased to 1⅜ of an inch, and a strong thread was cut on to the lower end, so as to adjust them to the requisite lengths.

In the place of the cast iron bearers cross beams were substituted, composed of two Memel planks, 13 inches deep, 3½ inches thick, bolted together, and trussed with a round bar 1⅛ inch diameter; every sixth beam had a deep trussed frame on the under side, so as to give great stiffness. Above and beneath the cross beams, on each side of the carriage way, were bolted two sets of longitudinal timbers, four in each set; they were further united by cast iron boxes, at intervals of 10 feet; and the ends were secured to beams of English oak, built into the masonry of the towers. A curb of Memel timber, 11 inches by 6 inches, was attached to the ends of the cross bearers, and extended the whole length of the platform.

The planking of the footways was composed of narrow battens, 2 inches thick, laid transversely from the inner longitudinal beam to the outer curb piece, with an inclination or drip of 1½ inch in 5 feet.

The carriage way was formed of four thicknesses of Memel plank; the two lower layers, each 2 inches thick, were placed diagonally with the transverse beams, crossing each other so as to form a reticulated floor, abutted against the longitudinal beams; they were firmly spiked to the beams, and to each other, at all the intersections, and upon them was laid and spiked a longitudinal layer of Memel planking, 2 inches thick. Over the whole was fixed, transversely, a layer of slit battens, 1½ inch thick. Each layer was close jointed and caulked, and the upper one was laid in a mixture of pitch and tar. A composition of fine gravel and sand, cemented with boiled gas tar, was laid over the whole, to the thickness of 1 inch, forming the road track.

To add to the stiffness afforded by this construction, the author caused to be passed through the spaces between the pairs of longitudinal beams, a series of diagonal truss pieces of Memel timber, 6 inches square, with their ends stepped into the cast-iron boxes, which, at every 10 feet, grasp the beams. On the other ends of these diagonal truss pieces, cast iron boxes were fixed, which received the straining pieces, placed 3 ft. 6 in. above, and the same depth below, the roadway: an iron screw bolt, 1½ inch diameter, at every 10 feet, and a contrivance of wedges in the cast iron boxes, enabled any degree of tension to be given to the framing.

The roadway was thus stiffened by two of the strongest kinds of framing, in parallel lines, dividing the carriage way from the foot-paths; it was deemed preferable to disconnect them from the suspending rods, and, by bringing them nearer together, to avoid a twisting or unequal strain. The whole formed a compact mass of braced wood work, the diagonal planking giving the horizontal stiffness, and the two trussed frames insuring the vertical rigidity.

The weight of the new roadway was—

	Tons.	Cwt.
Wood work	130	19
Cast and wrought iron about ditto	36	6
Wrought iron in the suspending rods	20	14
Ditto in the fencing	8	18
Gravel concrete	30	0
Total	226	17

Or 47.5 lb. per square foot, superficial, for the entire roadway.

* Minutes of proceedings, pages 167, and 204.

The weight of the original roadway was—

	Tons.	Cwt.
Wood work	69	0
Cast iron about ditto	92	0
Wrought iron in the suspending rod	12	9
Gravel concrete	30	0
Total	203	9

Or 23 tons less than the new roadway.

Cost.—The platform described is 412 feet long, and 27 feet wide; it cost £4026 or about 7*s.* 3*d.* per superficial foot.

The works were completed in the summer of 1840; the bridge has borne without injury the gales of the last winter; and the stiffness of the platform has given confidence in its strength to all who have examined it.

Five elaborate drawings of the bridge, giving all the details of its construction on a large scale, accompanied this communication; they were presented by Mr. Page on his election as an Associate of the Institution.

Mr. Seaward agreed with Mr. Rendel in the advantage of reducing the number of suspension chains, and thus rendering the whole construction as simple as possible. The trussed framing, which appeared to be the main feature of this bridge, was particularly deserving of commendation, as it imparted a degree of stiffness to the platform which had not hitherto been attained in other cases, although it was demonstrated to be the best method of preventing the undulation which was so prejudicial to the suspension bridges.

Mr. Rendel had, on a previous occasion,* explained his view of the action of wind upon the platforms of suspension bridges, and of the necessity of a certain degree of stiffness in the construction; this he conceived would always be better attained by having a simple well-trussed framing to prevent undulation, than by the application of braces or stays to check either undulation or oscillation—the latter being in his opinion only the result of the former.

He would now only insist more forcibly upon those points. The roadway should be so stiff as to prevent as much as possible all tendency to motion, because it added to the natural decay of every part of the structures; for instance, he found on taking down the chain of the Montrose Bridge, after seven or eight years' wear, that the pins of the links were cut some depth into; demonstrating how great had been the amount of motion among the links. In constructing suspension chains, after this experience, he should be inclined to abandon the circular form for the pins, and forge them of a long oval shape in their transverse section; making the apertures in the links by drilling two holes, and cutting out the metal between them with a machine; this form of pin would allow sufficient play for the necessary curve of the chain, while the pin itself would be stronger, would weaken the link less than the large circular hole, and would be less expensive to manufacture. He disapproved of all the complicated contrivances for allowing expansion of the main chains; he had found that plain saddles of proper form were quite sufficient to permit the expansion of the back chains, which was all that required attention.

Mr. Palmer mentioned, on the authority of Mr. Chapman, the destruction of a suspension bridge in America, caused by the sudden passing of a drove of cattle when frightened. This was peculiar, as it always had been considered that an irregular motion was innocuous, but that when any regular impulses were communicated, there was danger of fracture of the bars.

Mr. Vignoles eulogized this excellent communication for the practical conclusions which it contained. Mr. Rendel had materially assisted in affording facility of communication by the introduction of the floating bridges, in communication with railways, and it was not difficult to foresee that, by carrying out the system of adapting well-trussed framings to the platforms of suspension bridges, sufficient rigidity would be attained for locomotive engines and carriages on railways, to traverse rivers or ravines by means of these bridges, instead of by costly viaducts or heavy embankments.

Mr. Rendel saw no difficulty in giving any required amount of rigidity to the platforms; it was only necessary to increase the strength of the framing, to enable the roadway to bear with perfect safety the passage of an engine and a train of carriages.

The President directed the attention of the members to what he considered the most valuable part of this interesting communication—the detection of the errors in the original construction of the bridge. This was the most useful class of papers which members could present to the Institution, and they were particularly valuable when they were illustrated by such complete drawings as those now communicated by Mr. Page on his election. He hoped this example would be extensively followed. He mentioned that an attempt had been made to carry a railway across the Tees by a suspension bridge, but it had been abandoned.

Mr. Rendel understood that the weight of the trains had so stretched the chains, or rather forced the moorings of the back chains of the bridge over the Tees, that the platform sunk in the centre so as to prevent the passage of the carriages; piles had therefore been driven beneath each bearer of the roadway, and the chains now remained merely to show that it had formerly been a suspension bridge.

May 4.—The PRESIDENT in the Chair.

"*Supplementary Account of the Use of auxiliary Steam Power, on board the 'Earl of Hardwicke' and the 'Vernon' Indiamen.*" By Samuel Seaward, M. Inst. C.E.

* Minutes of Proceedings, page 205

The advantage of the employment of auxiliary steam power, on board large sailing ships, had been shown by the author in a former paper (p. 63); it was now further exemplified by the result of the recent voyages of the "Earl of Hardwicke" and the "Vernon."

Earl of Hardwicke.—This vessel, of 1000 tons burthen, with one engine of 30-horse power, effected the voyage from Portsmouth to Calcutta in 110 days, a much longer time than usual; but still with an advantage of 29 days over the "Scotia," a fine vessel of 800 tons, which sailed one week before the "Hardwicke," and arrived 22 days after her. During the voyage, the "Hardwicke" used her engine 364 hours, and was propelled by it 946 knots; an average of nearly three knots per hour: while in a calm, with the ship steady, she made five knots per hour. The total consumption of fuel was 90 tons.

The "Vernon," which sailed one month after the "Hardwicke," made her passage to Calcutta in 97 days; passed the "Scotia," and arrived seven days before her, gaining 42 days upon her during the voyage. The "Vernon's" consumption of fuel was also 90 tons, but the copy of her log not being arrived, the number of hours during which steam was used, could not be ascertained.

The "India" steam ship, of 800 tons burthen, with engines of 300 horse power, had not arrived at Calcutta, although she had been out 109 days, so that the "Vernon," with only auxiliary steam power, had already gained 12 days upon her.

The comparison between the advantages of these two vessels, in point of expense, is then fully entered into, and shows a saving of £3733 in favour of the "Vernon," on a single voyage, while she gained at least 12 days upon the "India," in point of time.

This communication is accompanied by a copy of the log of the "Earl of Hardwicke," and by letters from the captains of that ship and the "Vernon," speaking in the highest terms of the assistance of the steam power in certain parts of the voyage."

"Description of an improved Levelling Staff, and a modification of the common Level." By Thomas Stevenson.

In enumerating the advantages of this improvement, the author passes in review the different levelling instruments in general use. He describes the self-reading staff as very useful, but ill adapted to the extreme accuracy generally necessary in the operation of levelling.—He considers the running level to be equally inadequate, from the difficulty of attaining a precise coincidence in the cross wires and the vane line.

On the authority of Mr. Simms, in his Treatise on Mathematical Instruments, he states that these evils are in some measure remedied by Mr. Gravatts' rod, but he still considers that instrument to be imperfect. He therefore caused a rod to be constructed by Mr. Adie, of Edinburgh, the vane of which is adjusted by tangent screws. The range of this staff is 12·7 feet, and the graduation so perfect as to be read by verniers to the $\frac{1}{1000}$th of a foot. On the right of the lower portion of the rod there is a screw, which, on being tightened, clamps the vane, and on the opposite side is the tangent screw for adjusting it. Supposing in practice that the level line strikes the lower half of the rod, the vane and screw are then easily moved by the hand to within ¼ inch of the point, and then, by means of the tangent screw, perfect correctness can be attained.

After having sent his communication to the Institution, the author learnt from the Secretary that adjusting screws had already been used in two other levelling staves by Captain Lloyd and by Mr. Bunt. He was not, however, aware of this circumstance, and he considers that these instruments being adapted only for scientific purposes, are hardly suitable for the ordinary use of the engineer.

Improved Level.—The author also introduced a ball and socket joint at the junction of the legs of the common level, retaining at the same time the parallel screw plates, and adding beneath a small sluggish spherical level. By these means the surveyor is enabled to station the instrument, regardless either of the inequalities of the ground, or of the inclination of the telescope to the horizon.

When in use the clamp of the ball and socket is released, and the head of the level moved until the bubble shall be in the middle of the circle; the socket screw is then clamped, and the telescope brought to the absolute level by means of the parallel screws. It becomes thus unnecessary to move the legs of the instrument when once fixed.

"An improved mode of Paving Streets." By Edward Lomax.

In this communication the author proposes to remedy the danger and difficulty of stopping or turning horses during wet or frosty weather on wood pavement. His plan is, that a breadth of 2 feet 6 inches, near each side of the street, should be paved with stone, for the horses to travel upon, the carriage wheels still running upon wood; by which means all the advantages of that kind of pavement would be preserved without risk to the horse. In very wide streets a centre track might also be paved with stone.

By this plan the labour of the horse would be greatly diminished, a consideration portion of his power being now lost, because the wood pavement is less favourable for the footing of the horse than for the motion of the wheels.

The author is therefore of opinion, that granite pavement for the horse to travel upon, and wood pavement for the wheel way, would form a road on which the horse would work with the least loss of power, and the greatest safety.

A model of the proposed improvement accompanied the paper.

"Specimens of Sea-weed used for sea defences."

Mr. Macneill presented three specimens of the Sea-weed with which the Sea Embankments are formed in some parts of Holland.—He described one of the specimens in its natural state as resembling the weed which is collected by the peasantry on the western and north-western shores of Ireland, and used by them for bedding.—The second specimen was taken from near the bottom of the embankment at Niewe Diep, the entrance of the grand canal near the Helder. It was much compressed, but elastic.—The third specimen was less compressed; it was taken from the same embankment, above the range of the ordinary neap tides.

This embankment is of considerable width, and has very little slope towards the sea: the work appeared extremely compact and solid; he saw it when a heavy sea was running in, and each action of the waves against it caused a vibration throughout the whole mass—thus proving the elasticity of the material when consolidated, and corroborating the Hon. Mr. Stewart's description of the same effect upon the peat sod embankments, in a paper shortly to be laid before the Institution. Mr. Macneill spoke with confidence of the efficiency of the peat sod for sea defences, as he had used it with good effect, although at present only to a limited extent.

The attention of the Members of the Institution was especially directed to the sea embankments of Holland, as affording excellent study and ample materials for communications for the meetings.

On Lead Sheathing for Ships. By J. J. Wilkinson.

The commencement of this communication, which is the continuation of the paper on the "Wood sheathing of Ships," which was read March 23rd (page 318), examines in great detail the various uses to which metals were put in the earliest period of which any record exists, and then it traces the first application of lead to the protection of shipping.

There are very early instances of ships and vessels being covered with lead. In the 15th century, a boat, 30 feet in length, was found in the Mediterranean sunk in 12 fathoms water; it was built of cypress and larch. The deck was covered with paper and linen, and over all with plates of lead, fastened with gilt nails; this covering proved so impervious to moisture, that parts of the interior were perfectly dry. It is supposed to have lain there above 1400 years. A Roman ship was also found sunk in the Lake of Nemi. The hull was of larch; bitumen had been applied to the outside, over which was a coating of a reddish colour, and the whole covered with sheets of lead, fastened by gilt nails. The interior had a thick coating of cement made of iron and clay. The seams of the planks were caulked with tow and pitch.

Some of the ancient domes at Ephesus were sheathed with lead, and it appears that the column of Constantine at Constantinople was formerly covered with metal.

It is certain that lead mines were worked in Britain by the Romans; and long before the Conquest, plates of lead were used as coverings for ecclesiastical buildings. These coverings being designed to endure, were of very thick lead.

Water pipes.—In 1231, water was brought from Tyburn to London in pipes; but the material of the pipes has not been ascertained. In 1285, the great conduit in Cheapside was supplied with water conveyed through pipes from Paddington; these pipes are expressly stated to have been of lead. It has, however, been averred, that lead pipes for conveying water were first introduced by Robert Brook, in the reign of Henry the Eighth.

Sheet lead was used in Spain and Portugal for sheathing ships, and for covering the rudders, long before it was employed in England. It was used in Holland in 1666, and at Venice in 1710.—It is probable that we are indebted to Sebastian Cabot for its introduction into England; it is stated in his Memoirs that he first saw it used in 1514; he was then in the service of the king of Spain, which he entered in 1512, and was appointed pilot major; he afterwards returned to England, and in 1553 was named by Queen Mary, "Governor of the Mysterie and Company of Merchant Adventurers, for the discovery of Regions, Dominions, Islands, and Places, unknown."—Three vessels were fitted out for this purpose, under the command of Sir Hugh Willoughby, one of which was sheathed, or at least partly so, with thin plates of lead, then first mentioned as an "ingenious invention." This expedition was unfortunate—Sir Hugh Willoughby, with the crew of two of his ships, being frozen to death; one of the commanders, and his crew, alone escaped. This expedition was the origin of the trade to Russia, and of the Spitzbergen Whale Fishery.

In the reign of Elizabeth a patent was granted to one Humphrey, for melting lead, but was afterwards recalled, the plan not being new.

Milled lead.—It appears that, up to about 1670, cast sheet lead was used for sheathing; at that time milled lead was invented, and a patent for milling lead was granted to Sir Philip Howard and Francis Watson; by this process the inequalities, as well as the defects from air holes, in the former mode of manufacture, were remedied; the whole surface was rendered smooth and uniform, and the weight greatly reduced. This invention met with much opposition from the plumbers, who averred that it could not be durable; an offer was therefore made on the part of the Milled Lead Company, to keep in repair during 41 years all milled lead of the weight of 7 lb. per square foot, at the rate of five shillings annually per each hundred pounds worth in value.—One of the earliest vessels in the royal navy thus sheathed, was the Phœnix, a

fourth-rate. This was done at the express command of Charles II. This vessel made two voyages to the Straits, apparently for the express purpose of testing the new invention, and on her return in 1673, was careened at Deptford, and personally inspected by the King. An order was then issued that his Majesty's ships should in future be sheathed only with lead, excepting by especial order from the Navy Board. It appears that about 20 ships of the royal navy were consequently sheathed with milled lead, and fastened with copper nails.—Even the royal protection could not save this invention from cavillers, so that, in 1677 and 1678, complaints were made by Sir John Narborough and Sir John Kempthorne, that the rudder irons of the Plymouth and the Dreadnought were so much eaten, as to render it unsafe for those vessels to proceed to sea; these complaints were repeated in 1682.—The patentees maintained, on the contrary, that the damage to the rudder irons could not possibly arise from their being covered with lead, as it had been the invariable practice for a great many years, to secure the iron work of ships, generally, by lead covering, and especially by capping the heads of their bolts, under water, with lead, seized to and nailed over them. Reports too in favour of the invention were made by Sir Phineas Pett, and by Mr. Betts, master builder, at Portsmouth, in which the latter stated, that lead had effectually prevented the vessels becoming what is technically termed "iron-sick," meaning that the bolt-holes became so widened by corrosion, that the bolts were loosened; he recommended, however, that the lead sheathing should be stripped every seven years, on account of the decay of the oakum in the joints; declaring, too, that it became less foul on the voyage than wood sheathing, and was much more easily cleaned. These different opinions led to the issue of an Order in Council in 1682, for the appointment of commissioners to examine and report upon the alleged injury to the iron work by milled lead covering; it is probable their report was unfavourable, as it is said that the use of lead covering, fastened with copper nails, was abandoned on account of the rapid corrosion of the rudder irons. A controversy appears to have arisen on this subject, the merits of which it would be difficult to ascertain after such a lapse of years. Government, however, subsequently determined to make another trial of the value of lead covering; accordingly, the Marlborough was so sheathed, and laid up in ordinary, at Sheerness. A few years after, she was docked, at Chatham, in 1770, when it was found that the lead sheathing was covered with weeds, and the iron fastenings very much decayed; the lead was in consequence removed, and a wood sheathing substituted.

Mixture of metals.—Several patents were afterwards obtained for different mixtures of metal for this purpose, none of which seem to have succeeded, being all subject to the same inconveniences as the simple metal; among which was the influence of the sun in the torrid zone, which was said to reduce the lead, in the course of five or six years, to a calx.—Among these patents, for mixed metals for sheathing, is mentioned that of Mr. Bulteel, in 1693; it was found to have all the inconveniences of lead. Mr. Donithorne, in 1780, obtained a patent for sheathing, of a mixture of 112 parts of tin to 10 parts of zinc; this was also as objectionable as lead.—Slade's patent for sheathing with copper laid upon lead, and the patents of Wetterstedt, and of Muntz, for mixed metals, are examined; and the author promises a continuation of the subject, with the history of copper sheathing.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Eleventh Meeting, 1841.

(From the reports of the Athenæum.)

"*On Truscott's plan for Reefing Paddle Wheels.*"

Mr. Chatfield described, by reference to a model, an improved paddle-wheel, the principal feature of which was a new application of the principle of feathering and reefing. Each paddle or float is attached to an axis passing through its centre, with a crank at the extremity of the axis, and the feathering is effected by the motion of a roller attached to this crank, and moving in a groove eccentric to the wheels. The radii of the paddle wheel are connected at their extremities by a chain instead of a rigid rim, and the reefing is effected by drawing the radii together, like the folding of a fan, by means of a peculiar arrangement of the clutch box at the centre of the wheel.

"*On a Plan of Disengaging and Reconnecting the Paddle Wheels of Steam Engines.* By J. Grantham.

There are four cases in which it may be desirable to disconnect the paddle wheels from the steam engine in steam vessels, viz., when the vessel is on a long voyage, and the fuel must be economized as much as possible by using the sails on every favourable opportunity; when the engines are damaged, and, the vessel being close to a lee shore, it is necessary to disengage the engines quickly, to allow the vessel to make sail; when some derangement has taken place, and the engines are allowed to continue to work imperfectly to the end of the voyage, rather than detain the vessel by causing the paddles to drag through the water while the engines are stopped; when, the vessel being at anchor, the action of the swell and tide on the paddle floats, while stationary, causes a great additional strain on the cables, which would be obviated could the wheels play freely. The Admiralty had called attention to the subject, by inviting plans for effecting it. Several had been proposed for disconnecting the paddles, but Mr. Grantham is not aware of any plan having been proposed by which the wheels could be readily reconnected in a heavy sea. The crank pins are usually fixed in the cranks of the intermediate shaft, a little play being allowed in the eye of the crank of the paddle shaft, to prevent the crank pins from breaking when the centres of the three shafts vary from a straight line by the yielding of the vessel. For the purpose of disengaging and reconnecting, a brass box of a rectangular form is inserted in the eye of the crank of the paddle shaft, which can be moved several inches by means of a screw at the back of the crank. The eye of the crank is so made that two of its sides may be cut away, and through these openings the crank pin can pass when the box is drawn back, or the disengaging effected. The brass box has one of its sides, which restrain the crank pin when in gear, cut away one or two inches to assist in reconnecting the engine, which is effected by screwing the box out one or two inches, or just so far that the crank pin can pass the side which has been cut away, and come in contact with the higher side. This is the correct position for reconnecting, which is accomplished by a single turn of the screw.

Mr. Grantham, in reply to a question from Capt. Taylor, R.N., stated that he should consider it very dangerous to disconnect the paddle wheels without having first stopped the engine.

"*On the Propulsion of Vessels by the Trapezium Paddle-wheel and Screw.*"

Mr. G. Rennie gave an account of the various experiments to which he had been led, on the propulsion of vessels by various forms of paddle floats and by the screw. It was generally admitted that the paddle wheel was the best means of propulsion with which engineers were at present acquainted, and various attempts had been made for its improvement. There are several objections to the square or rectangular floats, particularly the shock on entering the water, and the drag against the motion of the wheel on the float quitting the water; both of which give rise to considerable vibrations. He had been led, in considering the improvement of the paddle wheel, to have recourse to nature; and the form of the foot of the duck had particularly attracted his attention. The web of the duck's foot is shaped so that each part has a relation to the space through which it has to move, that is, to the distance from the centre of motion of the animal's leg. Hence he was led to cut off the angles of the rectangular floats, and he found that the resistance to the wheel through the water was not diminished. Pursuing these observations and experiments, he was led to adopt a float of a trapezium or diamond shape, with its most pointed end downwards. These floats enter the water with their points downwards, and quit it with their points upwards, and then arrive gradually at their full horizontal action, without shocks or vibrations; and after their full horizontal action, quit the water without lifting it, or producing any sensible commotion behind. After a great variety of experiments, he found that a paddle wheel of one half the width and weight, and with trapezium floats, was as effective in propelling a vessel as a wheel of double the width and weight with the ordinary rectangular floats. The Admiralty had permitted him to fit Her Majesty's steam ship *African* with these wheels, and he had perfect confidence in the success of the experiment. Another means of propulsion was the screw, which had been applied with success by Mr. Smith in the *Archimedes.* In examining the wings of birds and the tails of swift fish, he had been particularly struck with the adaptation of shape to the speed of the animals. The contrast between the shape of the tail of the cod-fish, a slow moving fish, and the tail of the mackerel, a rapid fish, was very remarkable,—the latter going off much more rapidly to a point than the former. From these observations he was led to try a screw with four wings, of a shape somewhat similar to these, but bent into a conical surface, the outline being a logarithmic spiral. He found also that certain portions of these might be cut off without diminishing the effect. With respect to ascertaining the friction of the screw on the water, great difficulty existed; but he would refer to his experiments, published some years ago in the Philosophical Transactions, in which he measured the friction of the water against a body revolving in it, by the time which a given weight took to descend; this body consisted of rings, and he found that the friction or resistance through the water did not increase in proportion to the number of rings.

"*On a Floating Breakwater.*" By Capt. Taylor, R.N.

The breakwaters hitherto constructed have generally consisted of solid masonry, thus presenting an unyielding obstacle to the waves, and permitting accumulations of mud and sand behind them, and not affording the security to shipping and life which is required, and may be afforded by other means. The floating breakwater consists of floating sections framed of timber, moored to piles; these sections yield to the shocks of the sea, and admit the wave to pass under, over, and through them, and by thus dividing the waves, reduce them to an open and harmless state. The forms of these sections vary according to the situations in which they are employed. The sea in the most tempestuous weather is said to be tranquil at the depth of sixteen or eighteen feet below the surface; a breakwater, therefore, immerged to that depth, and presenting six or eight feet above the surface, is sufficient to form a safe harbour on the most boisterous coast. The angle of inclination which the section presents to the wave is that pointed out by nature in the Mew-stone, viz. 35 degrees. Stone breakwaters check the ground tides, and cause accumulations of mud and deposits which otherwise would go seaward, and are peculiarly subject to the action of the teredo, constantly at work below the dove-tailed stone; and cavities being formed, large portions are occasionally blown up. The destruction by the teredo may be obviated or arrested in the floating breakwater by tarring the wood with a preservative mixture, or by restoring from time to time such portions as are injured. The distinction

between waves and breakers is very important, the former being an undulation, the latter being accompanied with a translation of the mass, and capable therefore of exerting extraordinary forces on the masses opposed to them.

Some remarks were made on statements in another Section, respecting the destruction to which the limestone of which the Plymouth Breakwater is exposed from certain animals (*Saxicava rugosa*). These animals do not, however, meddle with granite, and probably timber payed over with hot tar would resist their ravages, as animals of this nature seem peculiarly averse to the smell of tar and similar substances.

"On Forms of Vessels."

Mr. Scott Russell reported the progress made by "the Committee on Forms of Vessels" during the past year. The object of the experiments is two-fold—to advance our knowledge of the laws of resistance of fluids,—and to obtain data for the practical improvement of the art of naval construction. Many and expensive are the experiments formerly made on this subject. Unfortunately, these experiments had been made with imperfect apparatus, or under circumstances different from the conditions of bodies moving on the surface of the water, or on solids of a form unsuitable to the formation of ships, or on so small a scale as to render them unworthy of the confidence of the practical constructor. In the present series of experiments a more simple apparatus was employed than in any former series of experiments. The forms of body experimented upon were those of actual ships, or bodies analogous to those in use: it was the object of the experiments to supply the actual desiderata of hydrodynamics and of practical ship building. The experiments were made on vessels of every size, from models of 30 inches in length to vessels of 1,300 tons. The experiments were also made upon vessels in water of variable depth and in channels of various dimensions, so as, if possible, to embrace all the elements of the resistance. A minute description of some of the apparatus was then given, along with some general illustrations; but as the experiments were still in progress, and to be continued during the following year, no general statement of results was entered into at the present meeting. It was expected that by the next meeting the whole would be concluded.

"On Captain Couch's Chock Channels."

Mr. Snow Harris explained and illustrated, by a model and drawings, the safety chock channel, for allowing the masts and rigging of vessels to be easily disengaged when the masts are carried away. Many cases have occurred in which, with the rigging and ordinary channels, the greatest danger has been incurred, in consequence of not being able to get clear of wreck. The ordinary channels may be blown up by the sea; whereas, if made solid, on Capt. Couch's plan, all danger from this source will be avoided, and the sailors would be at once able to clear the vessel of any wreck.

"On Arnott's Stove, and the Construction of Descending Flues, and their Application to the purposes of Ventilation." By J. N. Hearder.

The general advantages of Arnott's stoves in economizing fuel, avoiding smoke, and regulating the temperature, are well known; but these stoves are attended with some disadvantages, of which the danger of explosion, and imperfect ventilation, are the most serious. The liability to explosion, Mr. Hearder considers to arise from the construction of the stove, in having the door air-tight; the only aperture for air being the valve aperture of the ash-pit. The air so admitted is immediately decomposed, and nearly the whole of its oxygen is abstracted, so that by the time it has passed up through the fuel, and reached the upper chamber of the stove, it has not oxygen enough left to support combustion. The heat evolved by the lower stratum of fuel, acting upon the upper stratum of fresh or unignited fuel, liberates from it the inflammable gas which it contains, and which also accumulates in the top of the stove. A mixture is then formed analogous to the fire damp of coal mines, ready for explosion whenever the requisite oxygen or degree of temperature shall be present. Under these circumstances, should the door be opened, a burst of flame outwards may be the result; or should a puff of wind down the chimney carry the mixture down through the ignited fuel, an explosion may ensue. Other causes, such as the sudden shutting or opening of the doorofan apartment, may occasion the downward draught and consequent explosion. Now carburetted hydrogen will not explode when the proportion of the air to the hydrogen exceeds a certain limit, so that if air be supplied to the top of the stove, so as greatly to preponderate over the hydrogen, the latter will burn off in a flame at the moment of its formation, or be carried up the flue. Mr. Hearder, therefore, proposes as a remedy, perforations through the lower edge of the door, so that air may be admitted on a level with the top edge of the fire brick, through which a constant in-draught of atmospheric air will be insured, sufficient to obviate the evil. The heat evolved by the perfect combustion of this inflammable gas, under these circumstances, will, he says, more than compensate for the admission of cold air into the upper part of the stove. The perforations just mentioned will also obviate, in a great measure, the want of ventilation. The author suggests a small rarefying apparatus, to be inserted in the vertical shaft connected with a descending flue.

"Some Experiments showing the possibility of Fire, from the use of Hot Water in warming Buildings, and of Explosions in Steam Engine Boilers." By Mr. Goldsworthy Gurney.

After detailing several instances of fire which arose from the steam pipes of water apparatus used for warming houses, the author proceeds to describe some of the experiments likely to be of practical value. From a tubular boiler, driving a high pressure engine, the injection pump was cut off—half an hour after the supply pump was stopped, no water appeared on opening the gauge cocks, and the engine was observed to slacken its rate and to move sluggishly—it had dropped from 50 to 30 strokes a minute. The steam pipe from the boiler to the engine was 40 feet long, and was carried for convenience through the open air, thickly wrapped round with woollen cloth to prevent radiation: soon after the engine became sluggish, the woollen cloth was observed to char near the boiler, which soon extended along the whole length of pipe; the engine still working, but with more apparent difficulty, making only 16 strokes per minute; the pressure gauge, which usually ranged between 30 and 40 pounds, now stood at 15, and was gradually sinking. In about five minutes after the woollen cloth had charred, a lead flange, used as a packing at the cylinder joint, melted, and was followed by a loud escape of elastic matter. The engine stopped working, and on bringing a lighted match into the escapage, it took fire, and burnt with the lambent flame of hydrogen gas. The author's impression was, that the escaping vapour was not pure hydrogen. Water condensed on a piece of cold iron held in the flame, but no water condensed on the cold iron after the flame was extinguished. On examining the boiler, all the tubes were found red hot. This experiment was repeated with many modifications. The temperature of the escaping vapour was ascertained by means of bars, previously prepared to melt at different temperatures; these indicated a temperature of about 400°. In about eight minutes a piece of pure lead melted—woollen cloth was charred, and a piece of tow held in the escapage took fire. In other experiments it was found, that the pipes became sufficiently hot to explode gunpowder, and many chemical preparations. Having satisfied himself of this property of heated steam or elastic matter, formed from the last portions of water in a boiler, the author proceeded to examine, as far as possible, its chemical nature—to determine whether any decomposition, or new elementary formation, took place. He found that the elastic matter was not condensible over cold water, and would not in many cases burn, or show any indications of the presence of hydrogen, or other inflammable matters. In some experiments it was found it would extinguish flame. The experiments with copper vessels afforded the same results as those manufactured from iron. From these experiments it appeared, that whenever the heating apparatus falls short of water, the elastic matter formed over the fire will carry sufficient heat through close pipes, to any distance, to set fire to wood and other combustible bodies, and that whether the hot water apparatus be under pressure or not, or whether the heating surface be of tubes, plates, or cylinders. On the other hand it would further appear, from some experiments enumerated, that in no case is there danger when a given quantity of water is present. Mr. Gurney suggests, that if both ends of the circulating series in hot water apparatus, namely, the part which immediately goes from the heating surface beyond the furnace, and that part where the circulation returns to it before it enters the furnace, was made of a metal which would not melt at the fair working temperature of the water, but which would melt at a temperature of from 5 to 600° of heat (say lead pipe), there would be little, if any, danger from fire.

It was mentioned that some experiments made many years since, by Woolfe, on some of the boilers of the Cornish steam engines, corroborated the facts now stated. It was also mentioned by Mr. Hunt, on the authority of Capt. Tregaskis, that where the boilers had been covered with sawdust, it was found in some instances, and in a very short time, to be charred.

"Account of the Strata penetrated in sinking an Artesian Well at the Victoria Spa, Plymouth." By Dr. Edward Moore.

The author pointed out the mode by which the operations were conducted. The strata penetrated were as follows:—Earthy clay slate, 20 feet; limestone, 150; blue slate, 20; red sandstone, 3; red slate, 37; limestone, 50; sandstone, 4; red and blue slate, 30; dunstone, 8; earthy clay slate, 20; red sandstone, 12; making a total of 365 feet. The earthy slates were of the character of those generally found under the limestone, but they were interspersed with blue shillat slates, similar to those which occur above it. From the circumstance of the slate rocks immediately below the red sandstone being in each instance tinged red, the author imagined that their colour might in these cases, if not in all, arise from the iron of the red bands affecting them by percolation. He next remarked that from the alternations of slate and limestone, the former appearing, from a consideration of the section, to come up in wedges through the latter, it might be possible that the opinion that some of the Plymouth limestones might have been formed in a manner analogous to the modern coral reefs, was founded on correct data, although in many other localities in the vicinity the bands belong to the same uninterrupted series of deposits. The quantity of water obtained was at first considerable, and overflowed the pipe; at present it generally remains about two feet below the surface, from whence it is carried to the saloon by a pump; it is clear and sparkling, and of a saline taste; it has been examined by Professors Faraday and Daniell, and found to contain in the imperial pint 8·100 cubic inches of carbonic acid gas, and 151·66 grains of dry salts, thus:—

Chloride of Sodium	96·64
Muriate of Magnesia	18·68
" " Lime	15·10
Sulphate of Soda	9·55
" " Lime	8·94
Carbonate of Lime	2·06
" " Iron...............	0·69
	151·66

Its specific gravity at 62° is 1013·3.

Prof. Sedgwick, after reviewing the general principle of Artesian wells, described two districts in which these operations were attended with very different results. In the eastern part of Essex the chalk is covered by sandy beds of the plastic clay, and these by several hundred feet of impervious strata of London clay, all dipping together towards the east. The arenaceous beds below the London clay rise higher towards the chalk than the clay does, and absorbs a considerable part of the water from the high grounds. By boring through the clays to this sand, springs of water immediately rise above the surface, and are carried off by natural channels. By this supply of water, the value of the land has been materially increased, since the country, though abounding in peat bogs, and stagnant ponds during winter, suffers much from the summer drought. The other attempts to form Artesian wells, referred to by Mr. Sedgwick, were made near Lincoln, which, though surrounded by fens, covered with water in the winter, is not sufficiently supplied during the summer. But the clays supporting the fens of the Bedford Level are below the chalk, and though there are pervious beds beneath them, which rise to the north-west, yet the clays are of such enormous thickness that they have never been penetrated; and even were that accomplished, the high land is so distant that intervening fissures, filled up with impervious materials, might intercept the supply. Expensive sinkings have been made at Lynn, and also at Boston, and after boring through many hundred feet of clay they have utterly failed, and in any future operations in this district the chance of success would be very remote. Mr. Sedgwick then observed with respect to the red colour of rocks mentioned by Dr. Moore, that he considered it simply owing to the red oxide of iron which might be present or not in any bed; sometimes the tinge was only superficial. In Nassau the red colour was owing to vicinity of trap rocks. He also observed, as to the condition of limestone rocks, that although they sometimes appear in masses, presenting a brecciated appearance, shells and broken corals being cemented together, yet generally they occur as regular parts of the series repeated without any regularity, in formations of all ages. In position and inclination they resembled their associated rocks, and partook in all their contortions and dislocations, except so far as their solid masses would resist mechanical movements, better than yielding deposits of sediment and mud. The organic remains found in limestones only differed from those in the other beds of the same age as far as the conditions differed under which each was deposited. At the present day different families of corals grow upon a solid and a soft bottom.—The Rev. W. D. Conybeare pointed out the similarity between Artesian wells and mines sunk in the coal measures. Artesian borings had been made with success near the outcrop of certain strata, but at a distance from this, although the combination of strata was the same, they had failed, from the great depth necessary to be penetrated. Now it is certain that the coal exists in many places beneath the new red sandstone and magnesian limestone, but at such depths that it would be hopeless to attempt to reach it. He therefore recommended to the attention of miners the formation of a series of Artesian borings in some of the coal districts, beginning where the probability was greatest, and proceeding from that point till the depth became too great. Such a series of experiments would show the nature and depth of the strata below, and over what extent coal might be worked without sinking shafts at enormous expense and with the risk of complete failure.—Mr. Bartlett observed, in confirmation of one of Dr. Moore's remarks, that where limestones abounded in corals, as at Berryhead, their structure was homogeneous, and exhibited little trace of stratification; when the corals were rare, the bedding became distinct.

"*Some Inquiries into the Causes of the increased Destructibility of Modern Copper Sheathing.*" By Mr. Prideaux.

In May 1840 Mr. Prideaux was applied to by Mr. Owen, of Her Majesty's dock-yard, to analyse some sheet copper from the sheathing of the *Sanspareil*, which had been on thirty years, and was still in good condition. The sample gave about 0·25 per cent. of alloy, chiefly zinc and tin. This contrasted well with a sample rendered unserviceable in a very short time (in only one year), and in which no quantity of alloy sufficient to weigh had been found; and the two agreed with two recorded analyses of Sir H. Davy and Mr. R. Phillips, the former having detected, in a very good sample of sheathing, about $\frac{1}{400}$ of tin; the latter having found the sheathing of the *Tartar* frigate (almost destroyed in four years, though never out of Sheerness harbour,) the purest copper he had ever analysed; and further with the reputed inferiority of the recently prepared sheathing of the Royal Navy, which must have been much purified by the repeated fusions it has undergone. The inference adduced was, that the presence of tin and zinc was favourable to the durability of the copper. Mr. Prideaux, however, proceeded with the analyses in other cases. Four were selected, viz.

From the	Copper on	Annual loss.
Minden	17 years	0 45 per cent.
Plover	only 5	11

Linnet, copper rapidly destroyed, could not be taken off sound enough to weigh a sheet.

New-sheathing prepared at Her Majesty's mills, Portsmouth.

There was no conformity between the results in these and the former experiments; they did not show any coincidence between the composition of the sheathing and its durability. The next step, therefore, was to examine how far it might be referred to any of the physical properties of the metal. To ascertain this, slips from each sample, all of equal surfaces (4 + 0·5 inch), were immersed each in a pint of sea water: the five vessels being placed side by side, so as to set them all in like conditions. Sea-water being electro-neutral, and acting *slowly* on copper, a little sal-ammoniac was added, to quicken the action without affecting the neutrality. The greatest waste was on the *Sanspariel*' copper, which had worn the best of all; the least on that of the *Plover*, one of the worst. Thus, in the laboratory, under parallel circumstances, they do not observe the same order of durability and waste as they had done in use. The cause of comparative waste appears, therefore, to be in part at least, due to *external conditions*, and of these two classes may be noticed: one depending on the connexion with the ship, the other on the circumstances of her employment. Of the first class two suggested themselves—the position on the ship's side, and the nails by which the copper is fastened. The lower part of a ship's copper seems to suffer much less than the upper, so long as she continues in deep water; but when she grounds at low water, if on black mud, this part suffers most from the action of sulphuretted hydrogen, peeling off in blue flakes. The influence of the nails offers rather more chemical interest. They are never of pure copper, and being very numerous, all in contact with the copper sheets, whilst their heads present also a considerable metallic surface to the salt water, they may produce very decided effects, either preservative or destructive, by a slight electro-chemical difference. Mr. Prideaux therefore examined a vessel which they were just then stripping, her copper being worn out in four years. It was found that round some of the nails the copper was quite entire, for an inch or two, though worn ragged in other parts; whilst elsewhere, and sometimes on the same sheet, the copper round other nails was quite gone, though other fragments of the sheet remained. Here some of the nails appeared to have exerted a protective, others a destructive influence. To ascertain the effect of the nails, five slips of new copper from the same sheet, and of the same size, were suspended equidistant, and at the same depth, in a vessel of sea water from the West Indies. The result was, that all the nails, except one (which was from Her Majesty's dockyard), appeared to act destructively. Here appears to be *one* instance of a protective nail, not enough so to prevent all waste of the copper, which experience has shown not to be desirable; but doubtless the preservative power may be increased to any requisite degree by attending to the composition of the alloy. The copper is alloyed chiefly with tin; but if the nail is at once hard and flexible the manufacturer is satisfied without examining what other metals are present. If they were always made just so much electro-positive to the copper as to protect the sheathing, so far as compatible with their own durability, they would seem to offer the simplest, most perfect, and most convenient means of electro-chemical protection. The damage to which the copper is subjected is affected by the circumstances of the ship's employment. Sheathing suffers most where most subject to wash and air, for friction is an agent in the waste as well as oxidation. It is also well ascertained that the copper sheathing suffers most in hot climates, which might be expected, upon a common chemical principle, that chemical action increases with the temperature; and it became a question whether this effect of heat, as well as its tendency to promote organic production and decomposition, might not form an important element in this destructive agency. Mr. Prideaux therefore obtained water from different parts of the Gulf Stream, with and without the weed, from the Caribbean Sea, and from Falmouth harbour, where the packets moored, the waters of which might possibly be affected by the mine drainings discharged into the river. Whilst these were being collected, Prof. Daniell's announcement of large quantities of sulphuretted hydrogen in the waters of the Guinea coast came before the public. To try the action of these different waters five copper slips, of the same dimensions, cut from the same sheet, were suspended in a pint each of the following samples of water:

1. Heart of the Gulf Stream.
2. Ditto with the weed.
3. Caribbean Sea.
4. Falmouth harbour.
5. Plymouth harbour.

After thirteen days they were taken out and reweighed, having been put in all bright, but cleaned, on taking out, only with a brush in soft water, as in the other experiments:—

	1.	2.	3.	4.	5.
Put in 16th........	180·26	182·56	190	169·01	176·41
Out 29th :........	178·45	182·3	189·6	168·55	176·1
Loss in 13 days....	1·81	0·26	0·4	0·46	0·31

No. 1, came out clean and bright, the others with tarnished surfaces, except No. 2, which was blotched and speckled. The Falmouth water presented no indications of being more corrosive than that of Plymouth, and Mr. Prideaux attributed the great difference of waste in these two cases to same unobserved difference of conditions in the experiment. But the excessive action of the Gulf Stream water, he considered too decided to be doubtful. Not only the quantity wasted, but the metallic clearness of the surface, showed a marked distinction. "But to whatever extent the recently increased waste of sheathing may fairly be charged upon the greater velocity, more constant employment, and greater consequent liabilities of weather and climate of our ships, particularly of the commercial classes, as well as to difference in the nails, I am inclined," said Mr. Prideaux, "to fear the fault is still to be sought in the copper itself. I have it on the authority of Mr. Moore, that the *Quarantine* cutter, generally at anchor in our harbour, was coppered in October 1832, and her copper is now in a very good state. Her last sheathing held good 14 years. The Eddystone tender, which also moors in Catwater, was cop-

pered in July 1838, and is now in much worse condition than the *Quarantine*, which has been on six years longer. That the waste on the Eddystone tender is not owing to her work, is evident, from the fact, that the upper part of her sheathing, which suffers the wash and friction, continues sound, whilst from beneath her floor the copper peels off in blue flakes. That this is attributable, in a great degree, to her occasionally grounding upon the black mud, which generates sulphuretted hydrogen and other corrosive matters, is very probable; the other never grounds, and does less work. Yet the difference is too great to be thus satisfactorily accounted for. The one is in good condition for nine years, the other comes to patch before the end of three: both lying the most of their time in the same harbour. On neither was there any distinct indication of protective or destructive influence in the nails." "Meanwhile, as nails must be used, and present a large metallic surface to the salt water, as well as numerous points of contact with the copper, calculated to give great effect to small electro-chemical differences, either in protection or destruction, it would seem that we ought to render them slightly electro-positive to rolled copper, by the addition of zinc, which would not injure their flexibility nor enhance their cost. The test, by the galvanometer, would be easily applied (after a little practice) in making up the metal for casting them, if it is of importance to continue the present system of their manufacture."

There is another method of protection, which came out in the course of these investigations; and which is beginning to occupy public attention. It was before noticed, that the upper part of the copper on the Eddystone tender, which bears the wash and friction of the waves, continues sound; whilst the bottom is fast wearing out. This exception, or rather subversion of the usual conditions, is owing to a coat of fish oil, laid on when the copper was new, to keep it bright; and not extended over the parts out of sight. Such a permanent effect could never have been anticipated from an oil which is not drying, and strongly indicates the facility, as well as efficacy, of this mode of protection. A still more striking case presented itself in the vessel which supplied the observations on the apparent influence of the nails. During our examination, we observed the complete preservative effect of some coal tar, which had trickled down over the copper, from the wood-work above. This had crossed the sheets just where most subject to the wash and friction; and whilst the naked metal had been quite worn away, the coal-tarred streaks remained entire, the surface of the copper, on melting off the tar, being as perfect as when fresh from the roll. Hence coal tar seemed to be an efficient preservative; but then recurs the question—will it keep a clean surface, free from organic adhesions and earthy incrustations? To embrace the opportunity for experiments, the vessel was sheathed with copper on one side and yellow metal on the other; and her fore-quarters to her mid-length varnished with coal tar, laid on hot, upon the metal also heated, by fires of chips round the sides. She has now been twelve months at sea; and, according to the last account, the varnished as well as the metallic surfaces, kept quite clean.

METHOD OF PREVENTING THE OXYDATION OF IRON.

By M. F. L. Allamand.

This composition, of a metallic nature, preserves iron and steel from oxydation, by entering into the pores without in any degree affecting their external appearance, or leaving the least blemish, so that steel instruments (including razors), fire-arms, &c., retain their polish, and are in some degree better fit for use, after having been subjected to the metallic application. Articles either plain or chased appear superior to platina, and retain, after the application, all the hieroglyphic characters, figures, letters, and other engravings, or cuttings, which were there previously.

COMPOSITION OF THE MATERIAL.

Pure Malacca Tin	120
Silver filings	4
Yellow tincal	12
Purified Bismuth	12
Purified Zinc	12
Regulus of Antimony	4
Nitre	11
Salt of Persicaria	1

Method of Purifying the Metals.—The tin ought to be melted separately 18 times. Each melting should remain about 20 minutes exposed to the action of caloric, and the impurities which arise on the surface should be carefully removed; it is thrown afterwards into a ley formed of vine twigs and persicaria (herb) in equal proportions. The bismuth, the regulus of antimony, and the zinc are also melted separately, but they only require it twice, and they are carefully run into an ingot mould, so that all impurities may remain at the bottom of the crucible. The tincal does not require any purification.

Mixture of the different substances.—The tin is the first material that is melted; the silver is afterwards added to it in small quantities, and in a few minutes afterwards the tincal, then the bismuth and the zinc in succession. As soon as it ascertained by the flames that the alloy is effected, the two kinds of salt are thrown in together, and are left to burn with vigour, and the alloy is stirred with an iron rod; after which it is carefully skimmed and poured into a vessel, to be made use of for the metallic application.

Method of applying the substance.—Before the piece of iron or steel is dipped in the recipient which contains the metallic mass already liquified, its surface must be rubbed well with a composition of sal-ammoniac and cream of tartar, in the proportion of 5 per cent. of tartar to the sal-ammoniac; the iron must then be dipped in the melted alloy, where it must remain only for a few seconds, and till it is perceived to be covered with a certain quantity of the metal. It is next placed in a wooden box of its own size, and in which there has been previously put a small quantity of sal-ammoniac and cream of tartar, in the proportions already indicated. It is again rubbed with a handful of tow, and a small quantity of the powder is put on the surface. In the course of this operation the steel loses its colour, and assumes that of silver. When this is done it is again plunged into the metallic mass for a few seconds, and when it is taken out it is again lightly rubbed with the tow to remove any superfluous particles. The article being perfectly clean and shining, it is plunged into a basin of cold water, into which there has been poured a bottle of spirits of wine of forty degrees of strength, in the proportion of ½ per cent. After having withdrawn it from the water, the article is rubbed carefully with a linen, then it is rubbed as carefully with some fine sand, that has been moistened, to remove the spots of smoke: it is at last rubbed a second time with dry sand, then with a linen, and finally with a leather. After all these operations, which require great celerity in the execution, the iron will remain impervious to oxygen, and by care it will preserve all its whiteness.—*Inventors' Advocate.*

APPARATUS FOR DISTILLING SEA WATER.

We have seen in operation, at Mr. Robinson's manufactory, Pimlico, an apparatus for evaporating water in large quantities. An authentic account of the apparatus has been given in the *Inventor's Advocate*, from which we give the following details:—

The principle on which the patent "Distillator" is constructed, is that of the continuous transfer of heat through a series of vessels by evaporation. Thus, steam being generated in the boiler, is admitted into a chamber surrounded by water, where it is condensed, forming distilled water. From that chamber the water is permitted to run off into a suitable vessel. The heat transferred from the condensed steam to the water with which the condensing chamber was surrounded, produces renewed evaporation, and the steam from that second boiler is conveyed to a second condensing chamber placed in a third vessel of water. The process is repeated in that vessel, and may be so continued through five or six condensing chambers. In the apparatus we inspected at Pimlico there are only three condensing chambers, and the hot water in the last vessel is pumped back to the first boiler until it becomes saturated with salt, and then it is blown off.

As in the ordinary process of distillation only one condensing vessel is used, it is evident that a positive saving of fuel must arise from the addition of other vessels in which a similar process can be carried on without the addition of fresh fuel. In the apparatus already constructed, it is found that by the addition of two chambers to the ordinary still, an increase of distilled water is obtained equal to from 130 to 140 per cent. The produce of the three condensing chambers, at a *minimum*, are three measures from the first, two from the second, and one from the third; the two last being equal to the evaporation from the boiler heated by fuel. At a *maximum* the quantities are: from the first, five measures; from the second, four; and from the third, three. This is equal to a gain of 140 per cent.

In the report of experiments made to the Lords Commissioners of the Admiralty, it was proposed to produce 20 lb. of distilled water by the combustion of 1 lb. of coals. This was actually produced by the apparatus, under a working pressure of steam in the boiler of 10 lb. to the square inch; but, as in subsequent trials, the working pressure has been reduced to 5 lb. the square inch, as a measure of safety, the effect falls short of 20 lb. of water for 1 lb. of coal, in a slight degree; but in a new apparatus, this can be amply compensated, by giving an increased evaporative power to the first boiler of the series, and by coating the whole with felt, so as to prevent the radiation of heat. In a trial of three hours duration, 59 gallons were evaporated from the three vessels as now constructed.

It is proposed, as a matter of convenience and safety, when the apparatus is employed on board ship, that the fire should be placed on the upper deck, and the distilling or condensing chambers on the lower deck, or in the hold. By this arrangement it is expected that the same fire which is used for cooking may be made the means of producing a constant supply of fresh water.

By the use of this invention, the necessity of encumbering a vessel with the usual cargo of water and tanks for a long voyage is entirely obviated, by merely substituting five per cent. of that cargo in coals for the distillation.

FRESCO PAINTING.

Mr. Haydon, with characteristic energy and enthusiasm, has made a trial in fresco, on the wall of his painting room; and the result of this first and hasty attempt is decisive of two important points—the beauty of fresco painting as a means of decoration, and the ease with which a knowledge of the practice may be acquired. The subject is a study for the archangel Uriel, the bust and arms only, of the life size; it was painted at once on the plas-

ter, without a cartoon to work from, in four hours; the painter's hand trembling with apprehension for the success of his experiment, and incompetent from inexperience to do full justice to the means. It is a rough sketch, in short, made without the boldness and firmness of pencilling that certainty of purpose and mastery of hand alone can give. Yet the figure stands out from the wall, solid in form, lively in colour, and brilliant in tone, making the pictures beside it look poor, flat, and muddy in comparison; its flesh tints surpassing in purity the freshest oil painting. It has a majestic presence, that seems to enlarge the space it occupies, and to give new radiance to the light reflected from it; but while it thus fills the sense and elevates the mind, it is not obtrusive. In describing the impression made by this piece of fresco, our object is not to compliment Mr. Haydon, or to praise his design. We do but record the effect produced upon us by the work; though the conception and style of the painter must have had their share in producing this impression, we endeavoured to regard only the physical qualities of the art. The large scale of the design and the breadth and simplicity of the painting, have unquestionably a material influence over the mind; but these characteristics belong to all fresco, and constitute its chief recommendations; the greatness of the style powerfully aids the grandeur of the idea, and the largeness and boldness of the handling inspire the painter with congenial vigour of execution, which the cartoon he works from would prevent from running into exaggeration. As the tendency of high finish in cabinet pictures is to contract the focus of the mind and cramp the execution, so that of fresco is to enlarge the conception and expand the style. Fresco painting is the school of greatness in painting; it daunts and depresses only the little mind; it fires and elevates the noble and aspiring genius; the artist works with that grand gusto of which we hear so much and see so little. Mr. Haydon tells us, and we can well believe, that there is a fascination in the very manner of painting which is inspiriting and stimulating to fresh exertions; and he now regrets not having followed the advice of Sir David Wilkie twenty years ago, to apply himself to fresco. Any zealous artist might easily make the experiment; the same means of information are open to all. The book authorities for the Italian method, we are told, are Vasari, Armenini, and Cennini. Messrs. Latilla, of London, Bell, of Manchester, and Barker, of Bath, are the artists in this country whom Mr. Haydon consulted; Mr. Lane, of whom we spoke, is not, we believe, in England. The method is simple; chip off the outer surface of the plaster from a dry wall, and substitute for it a coating of wet plaster, composed of two parts of river sand and one of lime, well mixed together with water to a proper consistency; this applied to the wall will remain sufficiently moist to work upon for four hour; no greater space should be plastered at once than can be covered in that time. Every touch is indelible; but it may be gone over again when the plaster is moist. The pigments used are of the common kind, being earths, and are dissolved in water; the lime itself is white; the difficulty is to allow for the change of tint in drying.—*Spectator.*

REVIEWS.

Illustrations of Arts and Manufactures. By Arthur Aikin, F.L.S., F.G.S., &c., late Secretary to the Society of Arts. London: Van Voorst, 1841.

Arthur Aikin is the scion of a literary house prolific in respectable names—we need only mention Dr. Aikin, Lucy Aikin, and Mrs. Barbauld. For a long while he was, as Secretary of the Society of Arts, the friend and adviser of the majority of the mechanical world, and well did he sustain his own position and the character of the institution. As a popular lecturer on subjects connected with the practical arts few could exceed him, for while he possessed the art of riveting the attention of his auditory, he was remarkable for a precision of idea and expression, which, even without the aid of diagrams or engravings, enabled him to give complete and correct ideas of most intricate and complicated machinery. So well was this known to be Mr. Aikin's characteristic, that Lord Brougham, himself no mean authority, is reported to have recommended a friend to apply to Mr. Aikin, as he knew "no other man but he who could make a specification without drawings." When Mr. Aikin retired from the post, which he had occupied so long, it was to the general regret, but still we hoped that one who had led a life so active and useful as his has been would not remain idle in his retirement, although he has well earned repose. We feel pleasure, therefore, in welcoming this first fruit of his retirement, which, as it is natural, is devoted to his ancient pursuits and connected with his former haunts. It is, what it purports to be, illustrations of arts and manufactures; it may, indeed, be considered as a manufacturing sketch or series of essays. The subjects treated on are pottery, limestone and calcareous cements, gypsum, furs, felt, bone, horn, &c., iron, engraving and paper. In their original form these papers were delivered before the Society of Arts, at their evening meetings, where we recollect the interest they excited; their republication therefore is likely to prove valuable.

From the article on pottery we have, at another page, given long extracts relative to brick-making, so that we cannot do better than here to take up the subject of limestones and calcareous cements. After tracing the origin of cement to brick-building countries, in the use of bitumen in the plains of Babylon. Mr. Aikin proceeds to allude to the improvements in its application which were made by other nations. To the Romans, however, he justly awards the palm among the ancients for their use of calcareous cements, on account of the extent to which they applied it in hydraulic works. They had also an advantage in discovering the use of puzzolana (vide C. E. & A. Journal, Vol. IV. p. 300.)* In alluding to the monuments of the Romans in this country our author says that the most ancient limestone quarries in this part of the empire, and which continue in full activity, were first opened by the Romans at Tadcaster, in Yorkshire, which, in the Roman itineraries, is named Calcariæ. In giving this praise to the Romans, it is to the Gothic style that we must refer the great extension given to the use of cement, the intricacy and elaborateness of its parts, its richness and multiplicity of ornament, not allowing the use of large blocks of stone. Limestones, Mr. Aikin divides after the usual arrangement into four classes. The first contains the pure limestones, including white statuary marble (which is of no use for mortar), white chalk, oolite, and gray limestone. In the second family are placed the swinestones and bituminous limestones, which are of value. Magnesian limestones come next, and lastly limestones containing so large a proportion of iron and clay as to enable them to form cements, which have the property of becoming solid under water, and are for this reason called water or hydraulic cements. (On this subject see also M. Vicat, p. 3 of our present volume). Among these are gray chalk, chalk marl or Dorking lime, found in large quantities at Dorking, Merstham and Halling; blue limestone, lying betweeen the lower oolite and the new red sandstone running across the country from N.E. to S.W. from Whitby to Lyme Regis, sending out a branch to Monmouth and Glamorgan. The entire thickness of this deposit is 450 feet, and among its chief quarries are Watchet, Aberthaw, Barrow and Bath. In the three former, according to Smeaton, the proportion of iron and clay appears to be the same, or about 11 per cent., but in the time of Barrow, according to that authority, 21·3, but according to Mr. Marshall, 14. In the upper and lower beds of the lias formation, and in all deposits of bluish slaty clay containing carbonate of lime, are balls of a compressed globular figure, less clayey than the slate marl, but less calcareous than the limestone. In the London basin these balls in the blue clay are called septaria or cement stone. They may be observed in the cliffs of London clay forming the eastern coast of the Isle of Sheppey, and in the low cliff at Southend in Essex. They were met with frequently in the cutting for the Highgate Railway and Primrose Hill tunnel. Of late years these stones, burned and reduced to powder, have been very extensively used under the name of Roman cement, in all water building and other masonry requiring particular care, with such success as to have entirely superseded the employment of puzzolana and terras. These two materials should also be noticed; the first comprehends a few calcareous substances, the essential ingredients of which appear to be oxide of iron and burnt clay; the latter is quarried at Andernach on the Rhine for millstone, and the fragments are ground up in Holland, and mixed with lias lime to form a cement for dykes and other works of the water-staat. In England, Rowley rag, a basalt obtained from the Rowley Hills in Warwickshire, and in composition similar to the Andernach stone has been used for the same purposes with good effect. The Egyptians, as it will be seen under the head of Ancient Engineering, used black basalt from Abyssinia, With regard to sand, the use of pit-sand is objected to unless previously cleaned by washing, but sand having a yellow colour, caused by ochre, and having chalybeate springs rising from out of it, will produce a cement of great hardness, provided that it be used soon after it is dug. But limestone and sand are not enough of themselves; the limestone must be deprived of its carbonic acid, and used as soon as possible, as it reabsorbs carbonic acid from the atmosphere. When packed in close casks, lias lime will keep good for a long time, and Smeaton's experience goes as far as seven years, but in this case, the lime was previously reduced to powder by slacking with water, and then was trodden down into the casks. The lime having cold water poured upon it, becomes hydrate of lime or slacked lime, and in this state and not that of pure lime, enters into the composition of mortar. The proportion of sand in mortar depends partly on the fineness or coarseness of the sand itself,

* It was an ancient law in Rome says Pliny, that after the ingredients of mortar had been rubbed together with a little water, the mass should be kept in a covered pit for three years before being used; and we are expressly informed that buildings erected during the operation of that law were not liable to cracks.

and partly on the nature of the lime, but on account of the cheapness of sand there is always a disposition to deteriorate mortar by a too liberal employment of it. The proportions given by Pliny are 1 of lime to 4 of sharp pit-sand, and 1 of lime to 3 of round grained sand from the sea or river, an improvement, he says, may also be made by the addition of a third part of pounded tiles. The common London mortar is made of one part of white chalk lime and 2½ of clean sharp river sand, but not unfrequently, dirty pit-sand is substituted, and the lime itself, being imperfectly burnt, the mortar never becomes hard, and has not sufficient adhesion to the bricks. White lime, when really good, will take a larger proportion of sand than the brown limes do, but it is an additional proof of the badness of common chalk lime, that in the London practice the reverse generally prevails.

Upon the question whether any chemical action takes place between the lime and silica in mortar, Mr. Aikin admits that it is difficult to come to a decision, but he alludes to several facts which seem only explainable by the existence of chemical acts.

In enumerating the water cements our author states, on the authority of Vitruvius, that the cement used by the Romans in the construction of moles and other structures in the sea, was one of lime and two of puzzolana, from which the proportions of Mr. Smeaton's cement, used in the construction of Eddystone Lighthouse do not materially differ, namely, equal quantities of Aberthaw lime in the state of hydrate and in fine powder, and of puzzolana also in fine powder; the cement was also well beaten till it had acquired its utmost degree of toughness. The Dorking gray chalk is used in proportions of 1 of lime to 3 or 3½ of sharp river sand; and for filling in the interstices of thick walls, 1 of lime to 4 of coarse gravelly sand. In setting the bricks, that form the facing of the London Docks to the depth of 14 or 18 inches from the outside, a cement was used of 4 lias lime, 6 river sand, 1 puzzolana, and 1 calcined iron stone.

This sketch of Mr. Aikin's mode of treating one subject will be sufficient to give an idea of the work, which we leave with the conviction that it is one highly useful and instructive.

Letter from Sir Frederick Trench to Viscount Duncannon. London: Ollivier, 1841.

In this letter Sir Frederick proposes a railway from London Bridge to Hungerford Market, to run in the river parallel to the northern bank. This is to consist of an embankment one mile and three quarters in length, faced with stone or plates of cast iron to imitate stone; on this, 4 feet above high water Trinity mark, is to be a promenade, bearing on iron columns, 13 or 14 feet high, a railway thirty feet wide, to be worked by fixed engines on wooden rails. At intervals in the embankment are to be arches for the passage of barges. The embankment, railway and all, as far as we understand is intended to pass under the arches of the bridges. With regard to the bed of the river between the channel and the shore. Sir Frederick proposes to leave it as a space for a carriage road, wharfs, warehouses, houses, docks, or open mud banks as the case may be. The estimate given on the authority of Mr. Bidder and Sir Frederick Smith is, for the embankment £110,000, elevated platform £100,000, machinery £70,000, stations £25,000, interest £30,500, for filling carriage road, paving, lighting and sewers £100,000. Total £435,500. The time for the works is calculated at two years.

Sir Frederick urges the necessity for an embankment on account of the changes made by London bridge and the embankment before the new Houses of Parliament, from which he says have resulted a great increase of shoals, and the production of a number of mud-banks covered with vegetation, and in a pestilential state of decomposition. These are evils which are but too apparent, and it is evident both as a measure of health, commerce, and ornament, that some plan of embankment should be adopted, whether Sir Frederick's, Mr. Walker's, or Mr. Martin's, we do not say; but we feel sure that the day is at hand when a great and general improvement will be effected on the metropolitan river, and placing it on a par with its Parisian and Dublin rivals.

To the plan of Sir Frederick Trench there are many objections, and some, and not the least, are those suggested by considering it as a plan for the adornment of the metropolis. Passing, as this railway proposes to do, through three bridges and touching a fourth, it is evident that it will not only abstract from the grandeur, but absolutely spoil the view of those noble monuments, without any adequate compensation. The view of Somerset House will not be improved, and St. Paul's will be the only edifice which will derive any advantage, so that on that ground we fear that any measure so extensive is inexpedient. How the railway is to pass under the bridges we confess we do not see, and as to passing over them, it is out of the question A stronger objection is as to the effect such an embankment will have in producing depositions of silt and off below Woolwich, which may be looked upon as a certain result. As to the estimates, although a good foundation may in most places be obtained, we are decidedly inclined to think that they are too low.

We are willing, however, as we before said, to support some plan of embankment, but one so general we do not think under all circumstances is applicable. That the terraces of the Temple, of Somerset House, of the Adelphi, and of Hungerford Market, should be united, we are ready to admit, but we are well aware that there are great difficulties in the way. As to the consideration of making a profit from the undertaking, we think that they need not be taken into account on the present occasion, for the urgency of some plan of embankment is such that the funds must be furnished regardless of any other objects than the public benefit to be effected.

In thus dissenting from the details of Sir Frederick Trench's plan, we cannot do so without expressing how much the public are indebted to the gallant General for the great exertions he has made for the improvement of the Thames, and how much the successful result will be owing to his counsels and active co-operation.

CANDIDUS AND THE VENTILATION FOLKS.

"Cease rude boreas, blust'ring railer."

This humble petition is addressed to Candidus, who last month took out "a licence to blow on whom he pleases." We pray that he may abate his sweeping gale against the "ventilation folks," who most humbly acknowledge their fault in daring to acquaint the public that carbonic acid gas from a chimney—or sulphuretted hydrogen from a drain, do not strengthen the lungs, refresh the nerves, and invigorate the constitution. We will say with Candidus that the vocation of a tailor is more conducive to longevity than is that of a ploughman—that there is real salubrity below deck under London Bridge—even that a cargo of slaves enjoy the most refreshing change of air, and that their sickness and death of 50 in a hundred, is a proof of their sullen ingratitude to their owners. We will say that the metropolitan improvement trustees are egregiously in error not to consult Candidus. That old London may be revived with its neighbour-like projections, its lanes and alleys, so contributary to disease; its overground kennels, its annular visitation of plagues and pestilence, its lamentations and cries, bring out your dead; we will turn all serious proofs of modern blessings into frivolity for a month. We will say with Candidus, that the great orb of day, "is sun or moon, or a penny rushlight," to appease his anger; and when in cool reason he will debate upon this question upon which we live and die, "we will argue with him upon this theme until our eyelids will no longer wag."

Some of the Ventilation Folks.

THE NEW ROUTE TO INDIA BY THE EUPHRATES.

The *Commerce* publishes some private correspondence dated Aleppo, June 10, 1841, which states that the English steam boats Nimrod and Nitocris had arrived at Beles, on the Euphrates, after a navigation of 16 days and a distance of 375 leagues. Lieutenant Campbell, who commanded the expedition, had ascertained that both the Tigris and Euphrates are navigable for large vessels, and that those rivers present a new passage to the British possessions in India. "Documents stolen from M. Lascaris at Alexandria, in the year 1814," continues the writer, "contained important information collected by this gentleman, who was despatched by the Emperor Napoleon to explore Mesopotamia and the Euphrates, in order to ascertain the possibility of discovering a passage to India by the Orontes. The British Ministry determined to verify those plans. Colonel Chesney was deputed on this mission in the year 1835. Great Britain then ascertained that the Orontes, which falls into the Mediterranean, was navigable as far as Latakia (the ancient Antioch). That the ancient harbour of Selencia, situate at the mouth of this river, could be rendered an excellent harbour at a small expense. That it was easy to make a road to Aleppo, and thence to the Euphrates through the vallies, and that the distance, 45 leagues, could be easily traversed. A coal bed was discovered at the foot of Mount Taurus, 16 leagues from Tarsus. Near this coal bed, which is of considerable extent, has been discovered an iron mine, which gives 60 per cent. of metal. These mines are surrounded by oak woods of great value.

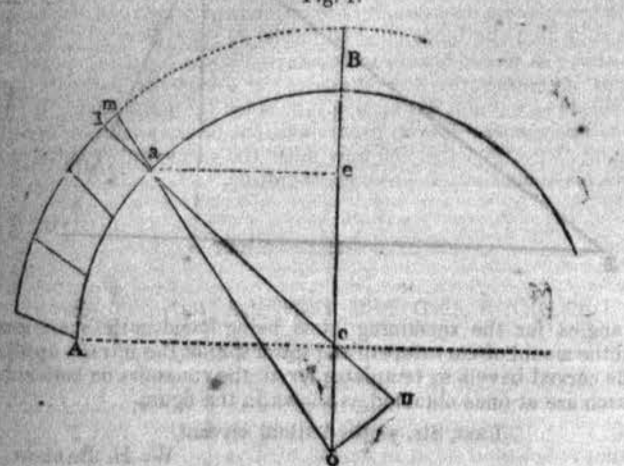
The writer calculates that the journey may be made from Bombay to Liverpool in 34 days—viz., from Bombay to Beles 16 days; from Beles to Alexandrette, 3 days; thence to Liverpool, 15. The letter concludes by stating that there is no doubt but that in a few years the English will monopolize the trade of Bagdad, Bassora, Aleppo, and all Mesopotamia.

3 B 3

ON THE CONSTRUCTION OF OBLIQUE ARCHES.

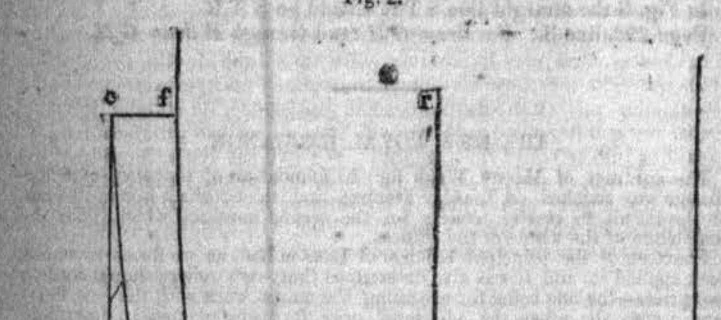
SIR—In compliance with the request contained in your letter of the 10th, I forward you the method by which the formula and construction given in your last number, for finding the angles between the joint lines in the face and soffit of an oblique arch, were obtained. The approximations thus arrived at are as accurate as it is possible to work to, the discrepance being much too small to be detected practically. As the subject is somewhat complex, I must be excused if the explanation here given is not strictly mathematical, the deductions however will be found correct.

Fig. 1.



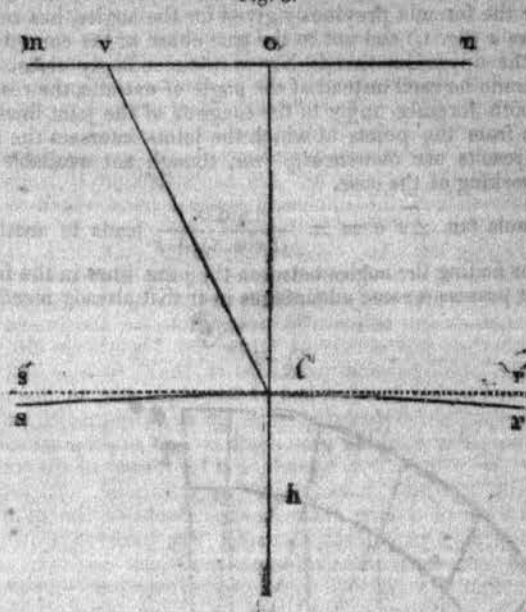
Let A B (fig. 1,) be the elevation of an oblique arch, on a plane at right angles to the axis of the cylinder on which it is formed, and let c be the centre, and a the point at which any joint $a\ m$ in the face of the arch meets the intrado.

Fig. 2.



Let C D E (fig. 2,) be the plan of the same, (part of the arch being supposed to be removed), and let a' be the position in plan of the point a (fig. 1.) Suppose a vertical plane P P to pass through the point a', intersecting the spiral surface $c\ f\ a'\ m'$ in the line $a'\ l'$. From l' let $l'\ m'$ be drawn a tangent to the spiral line of the extrado meeting D E in m'. And because the plane P P is perpendicular to the axis of the cylinder, the line of intersection $l'\ a'$ will be a straight line at right angles to the tangent $l'\ m'$. The triangle $a'\ l'\ m'$ is therefore the projection of a right angled triangle; and in the short distance $l'\ m'$ the tangent very nearly coincides with the plane of the spiral surface, hence the angle $l'\ a'\ m'$ will be a very close approximation to that formed between the chord of the curved joint in the face and the line $l'\ a'$; which is the angle represented by $v\ t\ o$, fig. 3, and that which it is required to find.

Fig. 3.



From o' where the axis intersects D E in plan draw $o'\ u'$ parallel to $l'\ m'$, meeting P P in u', produce $r\ o'$ to c'. In fig. 1 let $l\ a$ be the projection in elevation of the line $l'\ a'$; join $a\ c$ and produce it to u, making $l\ a : a\ u :: l'\ a' : a'\ u'$. Through u draw $u\ o$ at right angles to $a\ o$, meeting the vertical line B c produced, in o; and through l draw $l\ m$ at right angles to $a\ l$, meeting $o\ a$ produced, in m.

From the nature of the spiral surface it follows that $l\ a$ and $a\ u$ will be in the same straight line, and without going through the detail of each part of the construction, it will be seen that the triangle represented by $a'\ o'\ u'$ in plan, and $a\ o\ u$ in elevation, is a right angled triangle similar to, and in the same plane with the trangle $a'\ m'\ l'$, having the angle $o'\ a'\ u'$ equal the angle $l'\ a'\ m'$. Also that the side represented by $a\ o$ and $a'\ o'$ is the hypotheneuse, and is the line drawn from the point where the joint intersects the intrado to the point of convergence of the joints in the face; and that the side represented by $o\ u$ and $o'\ u'$, which is the perpendicular of the triangle $a\ u\ o$, is the hypotheneuse of another triangle whose perpendicular is $c'\ o'$, and the angle $c'\ o'\ u'$ equal to the angle of extrado. In the construction given in your last number, it will be seen that these are the two sides made use of to obtain the angle $u'\ a'\ o' = l'\ a'\ m'$, but in the formula it is more convenient to work with the base of the triangle $a\ u'\ o'$, which is the line $a\ u$ in fig. 1, and represented by $a'\ u'$ in fig. 2, for when we have given

$\angle$ C D E $= \theta$ the angle of obliquity.
$\angle\ c'\ o'\ u' = \varphi$ the angle of extrado.
$\angle\ a\ c$ B $= \lambda$ the angle from the vertical,
and $a\ c = r$ the radius;

then drawing $a\ c$ at right angles to B c fig. 1,

(Fig. 1) $a\ c = r \sin. \lambda, = a'\ c'$ (fig. 2).
(Fig. 2) $o'\ c' = r \sin. \lambda, \cot. \theta.$
(Fig. 2) $o'\ u' = r \sin \lambda, \cot. \theta, \sec. \varphi =$ the perpendicular.
(Fig. 1) $o\ u = r \sin. \lambda, \cot. \theta, \tan \varphi.$
(Fig. 1) $u\ c = r \sin. \lambda, \cot. \theta, \tan. \varphi, \cot. \lambda = r, \cos. \lambda, \cot. \theta, \tan. \varphi.$
(Fig. 1) $a\ u = r + (r \cos. \lambda, \cot. \theta, \tan. \varphi) =$ the base.

$$\text{Therefore } \tan \angle\ u'\ a'\ o' = \frac{r \sin. \lambda, \cot. \theta, \sec. \varphi}{r + (r \cos. \lambda, \cot. \theta, \tan. \varphi)}$$

Separating the constant from the variable quantities, and calling

$r \cot. \theta, \sec. \varphi = a,$
and $r \cot. \theta, \tan. \phi = b,$

$$\tan. \angle\ u'\ a'\ o' = \tan. \angle\ l'\ a'\ m' = \frac{a \sin. \lambda}{(b \cos. \lambda) + r}.$$

Hence if the arch be a semicircle on the square section, the expression for the angle $l'\ a'\ m'$ at the springing will be $\tan. \angle\ l'\ a'\ m' = \cot. \theta, \sec. \varphi.$

From the above may be proved the existence of the property discovered by Mr. Buck, namely, that the chords of all the joints in the face converge to one point below the axis; for $c\,o$ the distance of that point below the axis (fig. 1,) will be $o\,u \times$ cosec λ.

And $o\,u = r$ sin. λ, cot. θ, tan. φ.

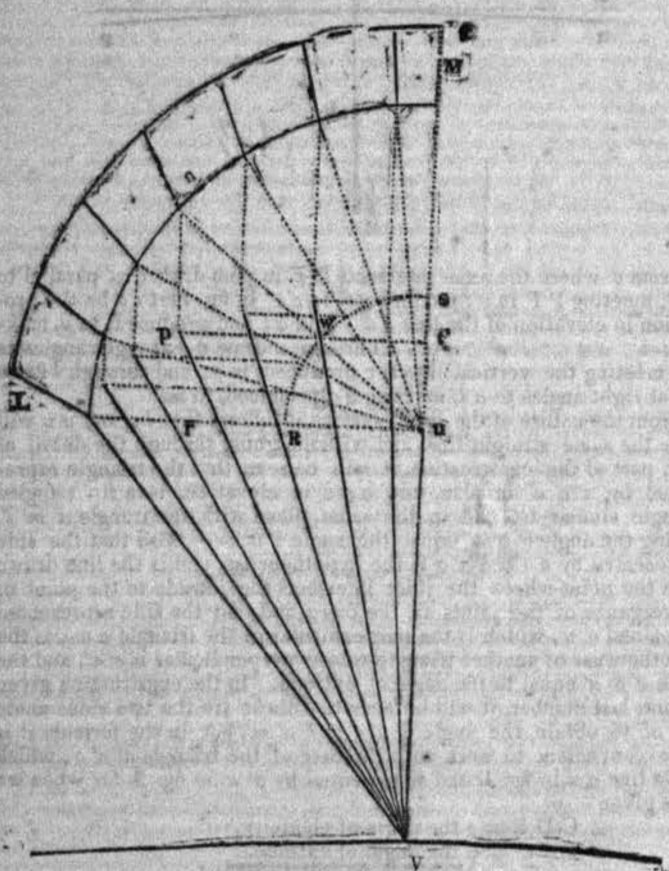
Therefore $c\,o = r$ sin. λ, cosec λ, cot. θ, tan. φ.

Whence the variable angle λ disappears, and $c\,o = r$, cot. θ, tan. φ.

This like the formula previously given for the angles, has reference to the line $m\,a$ (fig. 1,) and not to the true chord of the curved joint of the face; the approximation is however exceedingly close. If the angle of intrado be used instead of the angle of extrado, the results obtained by both formulæ apply to the *tangents* of the joint lines in the face, drawn from the points at which the joints intersect the intrado, and these results are *theoretically true*, though not available in the practical working of the case.

The formula tan. $\angle\, l'\,a'\,m' = \dfrac{a \text{ sin. } \lambda}{(b \text{ cos. } \lambda) + r}$ leads to another construction for finding the angles between the joint lines in the face and soffit which possesses some advantages over that already mentioned.

Fi 4.



* The dotted line $n\,p$ should be produced to r, and V u produced to t—the dotted line $p\,t$ should be a full line.

Let L M (fig. 4) be the elevation of the face of an oblique arch, on a plane at right angles to the axis of the cylinder on which it is formed, $n\,u$ being the radius.

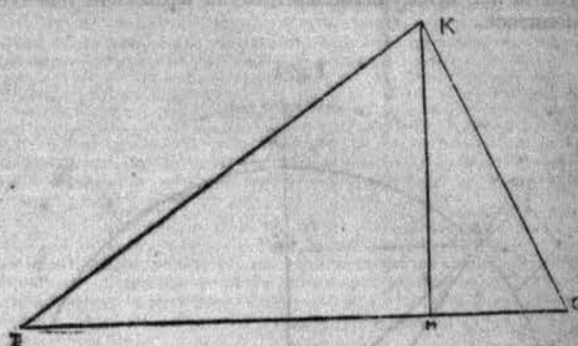
From the point K in the straight line K H, (fig. 5,) draw K F and K G, making the angle H K F equal the angle of obliquity of the arch, and the angle H K G the angle of extrado. Set off K G $= n\,u$ the radius, and through G draw G F at right angles to K H, intersecting K H and K F at H and F. Upon the vertical line M u produced (fig. 4,) set off $u\,v =$ F H, and from u with the distance H G describe the arc R W S. Then to find the angle formed out any joint n. Join $n\,u$ and through W where $n\,u$ intersects the arc R W s, draw $p\,t$ parallel to L u, and from n draw $n\,r$ parallel to M u, intersecting $p\,t$ in p. Join $p\,v$ and the angle $p\,v\,t$ is the required angle. For let F H $= r'$ and using the same letters for the angles as before.

$$\left.\begin{array}{l} \text{K H} = r' \text{ cot} \\ \text{K G} = r' \text{ cot. } \theta, \text{ sec. } \varphi. \\ \text{H G} = r' \text{ cot. } \theta, \text{ tan. } \varphi. \end{array}\right\} \text{fig. 5.}$$

$$\left.\begin{array}{l} t\,u = r' \text{ cot. } \theta, \text{ tan. } \varphi, \text{ cos. } \lambda. \\ u\,v = r'. \\ t\,v = r' + (r' \text{ cot. } \theta, \text{ tan. } \varphi, \text{ cos. } \lambda.) \\ \text{And } p\,t = r\,u = r', \text{ cot. } \theta, \text{ sec. } \varphi, \text{ sin } \lambda. \end{array}\right\} \text{fig. 4.}$$

Hence the ratio of $p\,t$ to $t\,v$ is the same as a sin. λ is to (b cos. λ) $+ r$, and therefore the angle $p\,v\,t$ is the same as that obtained by the formula.

Fig. 5.



The angles for the remaining joints being found in the same manner, and the mould of curvature of the spiral line of the intrado applied at V, the curved bevels or templates for all the voussoirs on both sides of the arch are at once obtained as shown in the figure.

I am, Sir, your obedient servant,

W. H. Barlow.

Brereton, September 17, 1841.

N.B. Will you be so good as to make the following corrections in my last communication.

In Fig 1 the letter A is omitted at the intersection of the lines E K and D C.

Fig. 4 should be Fig. 3, and Fig. 3 should be Fig. 4.

In Fig. 3 the straight line S T R should be S′ T R′.

Page 292, line 3. For *draw G H* read *through E draw G H.*

THE NEW ROYAL EXCHANGE.

The contract of Messrs. Webb for the foundation of the new Royal Exchange was finished on Tuesday evening, and the Gresham Committee met on the 1st ult. to receive tenders for the second contract, which is for the completion of the whole of the edifice.

Fourteen of the principal builders of London had, as we formerly stated, been applied to, and it was also determined that each tender should contain two prices—the one being for executing the mason work with the best Portland stone; the other, the additional price for using magnesian limestone, similar to that introduced at the Houses of Lords and Commons.

The amount of the several tenders were as follows, September 1, 1841 :—

Tenders.	Portland. £		Magnesian limestone. £
Thomas Jackson..........	115.900	..	124,700
Baker and Sons	122,765	..	127.300
Henry and John Lee	126.390	..	131,900
Samuel Grimsdell	126,762	..	133.348
Grissell and Peto	127,400	..	132,000
Piper and Co.............	128,700	..	131.100
John Jay	129.609	..	1[illegible]4,995
John and Joseph Little ..	129.800	..	134.300
Webb and Co..............	130,150	..	134,4[illegible]0
Joseph Bennett	131,500	..	133.500
Bridger..................	131.519	..	138,660
William Cubitt	132,200	..	135.700
Nicholas Winsland	134.219	..	136,620
H. Ward	135,500	..	138,500

The tender of Mr. Thomas Jackson was, of course, accepted. The whole of the works are to be completed by Midsummer, 1844.

The amount of the first tender for the foundations was £3124. See Journal, Vol. III. page 399.

Australian Steam Navigation.—Notwithstanding the wreck of one of the steamers, others have been sent out, and everything is now going on well.

Havannah.—A steamer has been started this month from Liverpool to Madeira, the West India Island and the Havannah.

SHANNON IMPROVEMENTS.

We have much pleasure in noticing the very spirited and energetic manner in which the Commissioners for the improvement of the navigation of the River Shannon, are carrying into effect the powers vested in them by Government—besides the various works in progress on the lower Shannon at Kilrush, Kilteery, Kildisart, and Foyn's Island, and in our immediate vicinity at Illanaroon, Plassy, and Killaloe. We learn that the same exertions are manifested to complete as soon as possible the numerous projected works on the middle Shannon, particularly at Meelick, Banagher, and Athlone, together with the important operation of dredging the bed of the river.

The principal feature of the improvements to be executed at Banagher, appears to be the erection of a new bridge over the Shannon, in place of the present old bridge, which measure has been found absolutely necessary, no less for the safety and accommodation of the public, than for the proper drainage of the country. The present bridge is built of rubble masonry, and consists of 17 arches of various dimensions, the piers of which occupy nearly one-half of the entire width of the river, the clear waterway being but 295 feet, whilst the total width of the piers is 244 feet. This structure is in a very dilapidated condition, and has lately shown numerous symptoms of its inefficiency as a means of communication between the King's County and Galway. It may however, be considered, (from its having been built in the reign of King John,) if not the oldest bridge over the Shannon, as at all events possessing an age which few other bridges can so satisfactorily trace, and is on that account, a very highly interesting work of antiquity. In its construction we find all that characterizes the early specimens of bridge architecture; the small arches for allowing the passage of the water, and, as before mentioned, unnecessarily wide piers, which have large angular projections not only to throw off the force of the current, but for the purpose of enabling passengers to retire into, to avoid carriages and horsemen when passing along its narrow roadway, the width between the parapets being only 12 feet.

The works of the foundation of the new bridge having been sufficiently advanced on the King's County side of the river, the first stone was laid by Colonel Jones, on Saturday, the 21st August; over which a brass plate was laid, bearing the following inscription:—

"SHANNON COMMISSION."

(Under the Act 2nd and 3rd Vic. Cap. 61.)

"By virtue of an Act passed in the second and third years of the reign of Her present Majesty Queen Victoria, the first entitled an Act for the improvement of the Navigation of the River Shannon, the following are the names of the Commissioners appointed for carrying the works into execution: Major-General Sir John Fox Burgoyne, R.E.K.C.B., K.T.S., &c. &c.; Lieut.-Colonel Harry David Jones, R.E., M.R.I.A., M. Inst. C.E.; Richard Griffith, Esq., C.E., F.R.S.E., M.R.I.A."

"This Bridge over the River Shannon at Banagher, was designed by Thomas Rhodes, Esq., C.E., M.R.I.A., M. Inst. C.E., the Commissioners' principal engineer, and the first stone laid on the 21st day of August, in the year of our Lord 1841.—Henry Buck, Esq., C.E., district engineer; Henry Renton, Esq., C.E. A. Inst. C.E., resident engineer; William Mackenzie, Esq., C.E., M. Inst. C.E., contractor.—Edward Hornsby, Secretary."

Having had an opportunity of inspecting the plans and other documents relative to the bridge, we are enabled to give some particulars which, perhaps, may be acceptable to our engineering readers. It is to consist of six semielliptical arches, of 60 feet span each, with a cast iron swivel bridge, of 45 feet span, to allow masted vessels and steamers an uninterrupted passage at all times. The following are the principal dimensions:—Span of stone arches each, 60 feet; rise of ditto, 16; thickness of abutment, 13; ditto of piers, 8; ditto of swivel bridge pier, 40; total length of bridge, including wings, 721; width of bridge, in clear of parapets, 24; ditto of carriageway, 16; ditto of each footpath, 4; thickness of arch stones at springing, 5; ditto crown, 2 feet 8 inches. The foundations will be all laid on a bed of strong gravel, at a level of about six feet below the bed of the river: the stone of which it is to be built is blue limestone, of a very fine quality, procured from a quarry recently opened adjacent to the works. The contract is stated to be about £23,000, and the whole of the works are expected to be completely finished in two years.

Mr. Faivelle is the contractor for building the much required pier at Kilrush, which is to extend 150 feet into the sea in a westerly direction, and there are 120 men now daily employed in the immediate neighbourhood quarrying stones for the work. The masonry embankment forming on the northern shore close to the present pier is very forward, and will be a great improvement.

Mr. Vignolles, C.E., son of the celebrated engineer of that name, is appointed resident engineer to superintend the construction of the piers or quays at Kilrush and Cahircon.

Mr. Sykes, of York, is declared contractor for building the pier of Cahercon, under the Shannon Navigation Commissioners, and the preparatory works will be commenced immediately.

The new pier, or quay, at Kilteery, between Glin and Loughill, in progress under the Shannon Navigation Commissioners, will be completed against winter, and admit of sailing vessels and steamers coming to there, in 21 feet of water, while the new road from Abbeyfeale, through the interior of the country, will render this a work of great public benefit to the farmer and trader—hitherto deprived of a market for their produce.—*Limerick Chronicle.*

Railway in the Brazils.—A railway has received the sanction of the Brazilian legislature and the support of the government, which is to run from Rio Janeiro to communicate with the provinces of St. Paulo and Matto Grosso. It has only one chain of hills to cross, the Serra de Parahyba.

STEAM NAVIGATION.

The Cairo.—A new steamer bearing this title made her first appearance in the Thames on Friday, 17th ult., and excited general attention. She was built by Messrs. Ditchburn and Mare, of Blackwall, for the Peninsular and Oriental Steam Navigation Company, for the navigation of the Nile, and is intended as a branch steamer to convey passengers and luggage to and from various places on the banks of that river. The Cairo is a remarkably elegant vessel, similar in appearance to those very fast and pretty steamers called the Watermen, running between London and Woolwich, and built by the same firm. The Cairo, however, is four feet longer and flat bottomed, to adapt her for the shallow waters of the Nile, her draught being only two feet. She is propelled by two engines of 16 horse power each, from the factory of Messrs. Penn and Son, of Greenwich. The cylinders are oscillating, and the machinery, which occupies a very small space, is precisely similar to that in the Watermen, and of the same dimensions. The cabins, fore and aft, are tastefully fitted up with bed places and other conveniences for passengers. The Cairo is an iron vessel, and divided into five compartments with water-tight bulkheads separating each, which adds much to the safety of the vessel. The engines and machinery occupy such a small space that 100 persons can be accommodated in the cabins, and there are two spacious stow-rooms for luggage only, between the engine-room and the fore cabin, and the engine-room and after-cabin. The Cairo made a trial voyage from the Blackwall pier to Gravesend and back, and with all the disadvantages attendant upon the working of new engines and machinery, she passed every thing on the river, the Star, a large Gravesend steamer, only excepted, and fully came up to the expectations of the builder and engineer. Mr. Ditchburn and Mr. Penn, jun., who entertained a select party of gentlemen connected with steam navigation on board, have guaranteed the average speed of the Cairo at 15 miles an hour; but for the Nile, a light draught of water is her greatest recommendation. Several other iron steamers, of similar dimensions, are to follow the Cairo to the Nile, and her design and appearance has been so much approved of, that the Watermen's Steam Packet Company intend to augment their fleet by five new vessels of the same size and machinery of the same power, to be in readiness by Easter Monday next. Messrs. Ditchburn and Messrs. Penn have taken the contracts.—*Times.*

Marine Engines.—It may be said that Great Britain is the manufactory for the whole world for marine engines; at one factory alone (Messrs. Maudslay and Field), there are at the present moment going through their various stages of manufacture, engines of 3600 horse power in the gross, viz. the *Devastation*, a government steamer with 400 horse power, fitted with double cylinders, now in the Woolwich basin just ready for action. The *Thames* and *Medway*, each with 400 horse power beam engines belonging to the West India Mail Company; the *Thames* is nearly ready; the *Herculana* (sister boat to the Mongebello) with 200 horse power, double cylinders, nearly completed for the Neapolitan government; and the *Memnon* with 400 horse power double cylinders for the East India Company. All the above engines are now being fitted on board of the several vessels—besides the above, in the same factory there are now in progress four pair of 150 horse, one pair of 100 horse for the Danish Government, and a pair of 100 horse for the admiralty all with double cylinders, also two pair of 50 *annular* cylinder engines on Mr. Joseph Maudslay's last patent. In another place we have noticed engines for Egypt and the United States.

The Satellite.—A beautiful iron vessel built by Messrs. Ditchburn and Mair has been running the last two months between the Adelphi and Gravesend with great speed and regularity. She draws but little water, and frequently steams the distance from Blackwall and Gravesend in about an hour; she has a pair of 35 horse *steeple* engines arranged expressly for her, which are a beautiful specimen of Messrs. Miller, Ravenhill and Co.'s. workmanship, they occupy a very small space in the vessel and are fitted with expansive gear worked with great simplicity.

Steam Towing.—We learn that during the present fruit season a steamer will tow vessels between Malaga and Gibraltar. It is to be hoped that this system of towing in the sea will be extended.

The Chili.—We regret to learn that this steamer has been wrecked on the coast of the same name.

FOREIGN INTELLIGENCE.

The Mosaic Pavement at Salzburg.—Munich, Sept. 7.—Private accounts from Salzburg state that it is intended to remove the lately discovered Roman mosaics from their present position, and lay them down in another situation, where they may be protected from the influence of the weather. It is said that the place fixed on is the site of Mozart's monument. Besides the large mosaic pavement, the design of which consists only of architectural ornaments and foliage, two smaller pieces were discovered, which are equally devoid of pictorial representation. There are likewise considerable remains of the walls of the chamber to which these mosaics belonged. The paintings on these are similar to those found at Pompeii, consisting of flowers and tendrils of vines on a red ground. The mosaics, as well as the paintings, are evidently of the third or fourth century after Christ. One very striking peculiarity in the smaller mosaics is the frequent introduction of the sign of the cross, which it is scarcely possible to regard as a mere accidental ornament. At the depth of half a foot below the large mosaic pavement, is another of finer workmanship, which, as it is necessarily the more ancient, promises to be an object of still greater interest. The proprietor of the house must have had some motive in thus covering over the old pavement and raising the floor. If once the upper pavement were removed, there would be no great difficulty in uncovering the second.—*Allgemeine Zeitung.*

St. Petersburg, August 26.—300 workmen are now daily employed in re-building the Imperial palace in the Kremlin at Moscow, which was pulled down four years ago. The new building is made fire-proof, the very rafters being of iron, and no wood being employed except for the floors. This palace is to be heated by means of 250 metal pipes communicating with every part of the building, and proceeding from a furnace contained in the vaults below. The ornamental gilding alone costs 300,000 rubles.

The great hall of St. George of the winter palace, which had just been re-built, had given way, and all the splendid Italian paintings and vases which it contained been destroyed.—The loss is estimated at several millions of francs. No life was lost; and the remainder of the palace was intact. On the day before the accident a chapter of the Order of St. George was held in the hall which has fallen.

Venice.—A bridge is about to be constructed at Venice, intended to unite that city to the Continent, and to connect it with the railroad of Milan. The management of this gigantic undertaking has been conceded to the engineer, Antoine Busetto Pitich; the average expense is estimated at 4,830,000 livres Austrian. The bridge will also contain an aqueduct intended to supply the town with fresh water, which has hitherto been supplied in boats from the Continent; Venice being unprovided with wells and fountains, and having but very few cisterns.

The Improvement of the Seine.—A commission has been appointed by the Prefect of the Seine, to take into consideration a project for improving the navigation of the river within and below Paris. Part of the project consists in establishing this navigation on the left branch, running along one side of the Cité. Another plan attached to it is the construction on the centre of the Pont Neuf of a vast building, from which eight turbines, of the force of 4000 horse power,(?) would throw immense quantities of water into every quarter of Paris.

Russia.—A joint-stock company in England has obtained the Emperor's permission to make an iron railway from Moscow to St. Petersburgh, and will begin its operations perhaps this autumn, but certainly in the spring. Five years are allowed to complete the whole line, which will be 33 miles longer than the common road between Moscow and St. Petersburgh, because it is to pass through to Bybinsk, in the government of Yaroslaw, on the right bank of the Volga, because that town carries on the most extensive corn trade with St. Petersburgh. All the vessels laden with the produce of the south, which comes up the Volga to the north, must stop here.—*Hamburgh papers, Sept.* 10.

The Rhein and Mosel Zeitung of Sept. 4 states, that in the course of the operations in the Cathedral of Cologne for the restoration of the pictures of the Saviour and the Apostles Peter and John, the workmen have brought to light several colossal figures which have been obliterated with whitewash during the last century. It is to be hoped that these figures will be restored along with the others to their original state. The same journal mentions that the two pictures which had been wantonly injured at the exhibition in Cologne have been again hung up in their places, after having been removed for the purpose of repairing them. In spite of every inquiry, the person who committed the malicious act has not yet been discovered, nor is it possible to assign any imaginable ground for so wanton an outrage.

MISCELLANEA.

The Sun Fire-office Building.—The dispute between the city authorities and the Sun Fire-office, is at last terminated by the consent of the latter body to set back their building to the act of Parliament line, and to round the corner at the south-east of Bartholomew-lane. The Commissioners of Sewers will pay, as the value of the land thus appropriated to the public, such a sum as may be determined upon by Mr. Cockerell, the surveyor of the Sun Fire-office, and some surveyor to be appointed by themselves. The directors of the Sun Fire-office have, in the opinion of the citizens, acted most unwillingly and ungraciously, and it would have been much more creditable to these directors to have conceded to general convenience, what was never equitably theirs, than, by persisting in forming this projection, to have compelled the Commissioners of Sewers to appropriate public monies to an improvement in which the Sun Fire-office was really as much interested as the public themselves.—*Times.*

New Mode of Rating the Gas and Water Companies.—Some of the parishes in the eastern districts of the metropolis have lately been making a valuation survey of the length and bores of the various mains and branch services belonging to the Water Companies in their respective parishes, as also the length of the gas-pipes laid down, and all property belonging to them, for the purpose of rating them on a fair and equitable per centage, in the place of allowing the companies to compound for them, by the payment of a stipulated annual sum as heretofore, and which composition has been found in reality to be much beneath their actual value. The companies' profits, it is well known, being very considerable, their property has not been rated in a fair proportion to the general property of the parish. By the adoption of rating the companies after the survey, the parishes will derive a great annual increase of revenue, which will contribute much to relieve the parishioners in general, by adding to the parochial resources. The example is about to be followed by other parishes in the southern districts, who are making surveys for the same purpose, where the source of revenue, increased by rating, will be much more considerable, in consequence of the immense quantity of water and gas-pipes laid down in the southern districts by several companies in rivalry of each other.—*Times.*

Improved Locomotive.—Messrs. Coulthard, of Gateshead, engineers, have just completed a powerful locomotive engine, including all the modern improvements, with also, in one respect, a novelty in construction of great practical advantage. This consists in the rejection of what we may call the "cinder-chamber," so that the bars are exposed to the external atmosphere, and the ashes fall directly upon the ground. Thus, the bars being presented to the cold air on the outside, they do not waste away with that rapidity which is consequent upon the ordinary construction, and considerable economy is the result. The engine being built more for power than for speed, the works are placed chiefly on the outside, and are of peculiarly easy access for purposes of repair. Trial was made of her powers on Thursday week, in the presence of Mr Wood, under whose superintendence she was built, and other gentlemen, who were much gratified by her performances; and after remaining for experiment on the Brandling Junction Railway a few days from this time, she will be removed to the Clarence line, to commence her labours in good earnest.—*Tyne Mercury.*

The Strike at the New Houses of Parliament.—The strike of the two hundred masons is likely to be productive of much injury to the working men, as they could not have chosen a worse plea on which to strike, while they have put themselves in direct contact with government. All combinations are bad, and particularly where they are employed to repress industry for the benefit of idleness. Nothing can be more infamous than a system which fines men for working faster than their fellows. The masters will gain by this imprudence.

Sir William Burnett's patent process for the preservation of timber, canvass &c. is gaining ground with the public; it has already been adopted by the government authorities at the dock yards. For the service of the Portsmouth Dock Yard, there is now being made at Messrs. Fairbairn's, Mill Wall, a large iron tank, 51 feet long and 6 feet diameter, with air and force pumps for the purpose of impregnating timber and canvass with Sir William's solution—it is also to be applied for the preservation of upwards of 6000 yards of felt, and the deal casing to be used for clothing the steam boilers of H. M. War steamer the *Growler*, now having her engines put on board at Messrs. Seawards manufactory at Limehouse.

Hoax by a Bank Clerk.—Last month we transferred into our columns an extract from the *Literary Gazette*, giving a short account of a newly-discovered method of propulsion, by which a common garden or invalid chair could be propelled along a common road by a galvanic power at the rate of 40 miles an hour; and it was further stated that the young man who had discovered this new power daily travelled in his chair from St. Alban's to the Bank of England in half an hour—a distance of 22 miles! Great curiosity was naturally excited by the supposed discovery, and the young man, who is a Bank clerk, was questioned concerning it, both by the governor of the Bank, and also by Mr. Smee, the cashier, &c. He was invited by the latter, and by several other persons, to display the powers of his new machine, but made repeated excuses for delay; he first excused himself on the score of illness, and on being again pressed to exhibit the machine, he stated that he had driven it accidentally against a post, and shattered it to pieces. Upon being, however, more closely questioned, he at last confessed that the whole story was a hoax, and that no such machine had ever existed, save in the fertile imagination of the supposed inventor. This *denouement* was only made known on Thursday, and it has created a great sensation in the Bank of England. The motive of the youth for the above hoax cannot be accounted for. We are informed, however, that some such galvanic power does exist,(?) but that the expense is too great to allow of its being made use of.—*Times, Aug.* 28.

Projected Light on the Goodwin Sands.—The Lords of the Admiralty and the Board of the Trinity-house have finally arranged with Mr. W. Bush, the engineer, that the cast-iron caisson, which he has now nearly completed at Deal, shall on Wednesday, the 15th inst., be floated to its place on the north-east end of the Goodwin Sands. It will be remembered some weeks ago we noticed the progress of this undertaking, which is now about to be sunk and firmly fixed to the chalk rock which Mr. Bush calculates on finding about 30 feet below the surface of the sand. The caisson will then form a base upon which a lofty column of stone will be raised, surmounted with a light, and that from its position and general usefulness to all maritime counties, it will be called "The Light of all Nations," which will be inscribed on the column. This new Goodwin light is not only designed as a beacon to warn the mariner off these sands, which have been so fatal, but is also intended as a guide from the North Sea, through a swashway, hitherto, from its danger, impracticable. This channel is about half a mile wide, and leads into a capacious bay within the Goodwin, having from 30 to 40 feet water, and being sheltered from every quarter, ships will there ride in safety. A very large party are going out on the 15th to view the floating of the caisson, and the Government steamers are ordered to be in readiness. It is expected that his Grace the Duke of Wellington, who takes a lively interest in the undertaking, will be present on the occasion.—*Times, Sep.* 6.

Newly Recovered Land.—Since the opening of the new cut from Eau Brink to Lynn, which took place about 20 years ago, the old channel, which was very wide and spacious, by which the water of the Ouse and its tributary streams were formerly conveyed to Lynn, has been gradually silting up, and much of it has now become firm land, producing rich and flourishing herbage. A few days since a portion of this newly recovered land (containing about 900 acres), which is now embanked and fenced with live quickset fences, and divided into convenient pieces for occupation, was let by auction, at the Globe Inn, Lynn, and the annual rental obtained for it averages nearly 3*l.* per acre. Calculating upon this ratio, were an embankment of the Wash to take place, the annual value of the land which would be obtained by that undertaking we might reasonably estimate at not less than £500,000. At the last quarterly meeting of the Lynn town-council, Mr. F. Lane laid upon the table a copy of a memorial presented to the Commissioners of Woods and Forests, which memorial referred to the inclosure of the Great Level of the Wash, and was accompanied with a letter, stating that the application to Parliament upon that subject was intended to be renewed in the next session.—*Norfolk Times.*

London Bridge.—This bridge is to be closed for the purpose of repaving the road, which is to be done with Aberdeen Granite, not exceeding three inches in width, to be laid in parallel courses.

Windsor Home Park.—Great improvements are going on by order of Her Majesty. A very neat iron bridge has been erected over the Datchet road which has been covered with the Seyssel Asphalte. Other works in Asphalte have also been executed at the castle.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 24TH AUGUST, TO 23RD SEPTEMBER, 1841.

Six Months allowed for Enrolment.

RICHARD WHITAKER, of Cambridge, machinist, for "*improvements in cutting the edges of books, and paper for other purposes; and in impressing ornaments, letters, and figures on the binding of books and on other surfaces.*"—Sealed September 4.

THEOPHILE ANTOINE WILLHELME COUNT OF HOMPESCH, of Mivart's Hotel, Brook-street, Middlesex, for "*improvements in obtaining oils and other products from bituminous matters, and in purifying or rectifying oils obtained from such matters.*"—September 4.

JOHN BOOT, of Quandron, Leicester, lace glove manufacturer, and JOHN KING, of Henor, lace-maker, for "*certain improvements in machinery or apparatus for manufacturing or producing figured or ornamented fabrics in wary and bobbin-net lace machines.*"—September 4.

JOHN GRAFTON, of Cambridge, civil engineer, for "*an improved method of manufacturing gas.*"—September 4; two months.

MICHAEL COUPLAND, of Pond-yard, Southwark, millwright and engineer, for "*improvements in furnaces.*"—September 4.

GEORGE WILDES, of Coleman-street, merchant, for "*improvements in the manufacture of white lead.*" (Being a communication.)—September 4.

WILLIAM HILL DARKER, senior, and WILLIAM HILL DARKER, junior, both of Lambeth, engineers, and WILLIAM WOOD, of Wilton, carpet manufacturer, for "*certain improvements in looms for weaving.*"—September 4.

LOUIS LACHENAL, of Titchfield-street, Soho, mechanic, and ANTOINE VIEYRES, of No. 40, Pall-mall, watch-maker, for "*improvements in machinery for cutting cork.*"—September 4.

JOHN JUKES, of Lewisham, gentleman, for "*improvements in furnaces or fire-places.*"—September 6.

PIERRE PELLETAN, of St. Paul's Church-yard, professor of medicine, for "*improvements in propelling fluids and vessels.*"—September 6.

JOSEPH DREW, the younger, of Saint Peter's Port, for "*an improved method of cutting and rolling lozenges, and also of cutting gun-wads, wafers, and all other similar substances, by means of a certain machine designed by him, and constructed by divers metals and woods.*"—September 6.

LUKE HEBERT, of No. 12, Staple's-inn, London, for "*certain improvements in apparatus and metals used in the manufacture of gas for illumination; also improvements in the apparatus for burning the same.*" (Being a communication.)—September 8.

RICHARD ELSE, of Gray's-inn, Esq., for "*certain improvements in machinery or apparatus for forcing and raising water and other fluids.*"—September 8.

WILLIAM FAIRBAIRN, of Millwall, Poplar, engineer, for "*certain improvements in the construction and arrangement of steam engines.*"—September 8.

JOSEPH COOKE GRANT, of Stamford, ironmonger and agricultural implement maker, for "*improvements in horse rakes and hoes.*"—September 8.

NATHANIEL CARD, of Manchester, candle-wick-maker, for "*certain improvements in the manufacture of wicks for candles, lamps, or other similar purposes, and in the apparatus connected therewith.*"—September 8.

JAMES THORBURN, of Manchester, machinist, for "*certain improvements in machinery for producing knitted fabrics.*"—September 8.

MILES BERRY, of Chancery-lane, civil engineer, for "*a new or improved method or means of, and apparatus for, cleansing typographical characters or forms of type, after being used in printing.*" (Being a communication.)—September 8.

OGLETHORPE WAKELIN BARRATT, of Birmingham, metal-gilder, for "*certain improvements in the precipitation or deposition of metals.*"—September 8.

JOSEPH GARNETT, of Haslingden, dyer, and JOHN MASON, of Rochdale, machine maker, for "*certain improvements in machinery or apparatus employed in the manufacture of yarns and cloth, and are also in possession of certain improvements applicable to the same.*" (Being partly a communication.)—September 8.

EDWARD LOOS DE SCHELESTADT, engineer and chemist, and ETIENNE STERLINGNE, tanner, of Regent's-square, in the county of Middlesex, for "*certain new or improved machinery or apparatus and process for tanning skins or hides, and preparing or operating upon vegatable and other substances.*"—September 8.

GEORGE MANNERING, of Dover, plumber, and HENRY HARRISON, of Ashford, plumber, for "*certain improvements in the means of raising water and other liquids.*"—September 8.

ALPHONSE RENE LE MIRE DE NORMANDY, of Redcross-square, Cripplegate, doctor of medicine, for "*certain improvements in the manufacture of soap.*"—September 8.

WILLIAM CROSSKILL, of Beverley, iron-founder and engineer, for "*improvements in machinery for rolling and crushing land, and in machinery to be used in the culture of land.*"—September 9.

WILLIAM HICKLING BENNETT, of Ravensbourne Wood-mills, Deptford, gentleman, for "*improvements in machinery for cutting wood, and in apparatus connected therewith, part of which may be applied to other purposes.*"—September 9.

CHARLES LOUIS STANISLAS BARON HEURTELOUP, of Albany-street, Regent's-park, for "*an improved manufacture of continuous priming for, and improved mechanism for the application of the same to, certain descriptions of fire-arms.*"—September 9.

CONRAD FREDERICK STOLTMEYER, of Golden-terrace, Barnsbury-road, Islington, merchant, for "*certain improvements in obtaining and applying motive power by means of winds and waves, for propelling vessels on water, and driving other machinery.*"—September 17.

WILLIAM NEWTON, of Chancery-lane, civil engineer, for "*improved machinery for manufacturing felts or felted cloths.*"—September 20.

JOSEPH HULME, of Manchester, engineer, for "*certain improvements in machinery or apparatus for grinding, sharpening, or setting the teeth of cards, or other similar apparatus employed for carding or operating upon cotton, wool, or other fibrous substances.*"—September 20.

THOMAS HUCKVALE, of Over Norton, Oxford, farmer, for "*improvements in horse-hoes, and in apparatus for treating and dressing turnips, to preserve them from insects, and promote their growth.*"—September 20.

ALFRED ELAM, of Huddersfield, surgical instrument maker, for "*improvements in apparatus for instruments for the relief and cure of procedencia and prolapsus uteri.*"—September 20.

LUKE HEBERT, of Birmingham, for "*improvements in machinery for fulling woollen cloth.*" (Being a communication.)—September 20.

WILLIAM CHARLTON FORSTER, of Bartholomew Close, gentleman, for "*a material, or compound of material, not hitherto so used for preventing damp rising in walls, and for freeing walls from damp, which material, or compound of material, can be applied to other purposes.*"—September 20.

FRANCOIS MARIE AGATHE DEZ MAUREL, of Newington Terrace, Surrey, for "*an improved buckle.*" (Being a communication.)—September 20.

GEORGE SHILLBEER, of Milton-street, Euston-square, carriage builder, for "*improvements in the construction of hearses, mourning and other carriages.*"—September 20.

WILLIAM BUSH, of Deptford, engineer, for "*improvements in the means of, and in the apparatus for, building and working under water.*"—September 21.

COMTE MELANO DE CALCINA, of Nassau-street, Soho, for "*improvements in paving or covering roads, and other ways, or surfaces.*"—September 21.

EDWARD EMANUEL PERKINS, of Weston Hill, Norwood, gentleman, for "*improvements in the manufacture of soap.*"—September 21.

JOHN DUNCAN, of Great George-street, Westminster, gentleman, for "*improvements in machinery for driving piles.*"—September 21.

HENRY BESSEMER, of Baxted House, Saint Pancras, engineer, and CHARLES LOUIS SCHONBERG, of Sidmouth Place, Gray's Inn Lane Road, artist, for "*improvements in the manufacture of certain glass.*"—September 23.

GEORGE SCOTT, of Louth, miller, for "*certain improvements in flour mills.*"—September 23.

JAMES WHITELAW, engineer, of Glasgow, and JAMES STIRRATT, manufacturer, of Paisley, Renfrew, for "*improvements in rotary machines to be worked by water.*"—September 23.

TO CORRESPONDENTS.

Mr. Pilbrow.—*We shall be happy to lay before our readers any new facts he may bring forward in support of his peculiar form of Engine, and when he has got the steam up in the 50 horse engine now constructing on his principle, we shall feel much pleasure in recording the results.*

Mr. Barret and Mr. Brooks.—*We have been again called to account by these two gentlemen, for not publishing their communications; we can assure them that it is our desire to accommodate all our correspondents if possible, but on account of the numerous articles connected with the profession which demand immediate attention, we are obliged to defer controversial articles; we will however endeavour next month to accommodate both Mr. Barret and Mr. Brooks.*

Probably after three years more practice F. will say that we have been merciful.

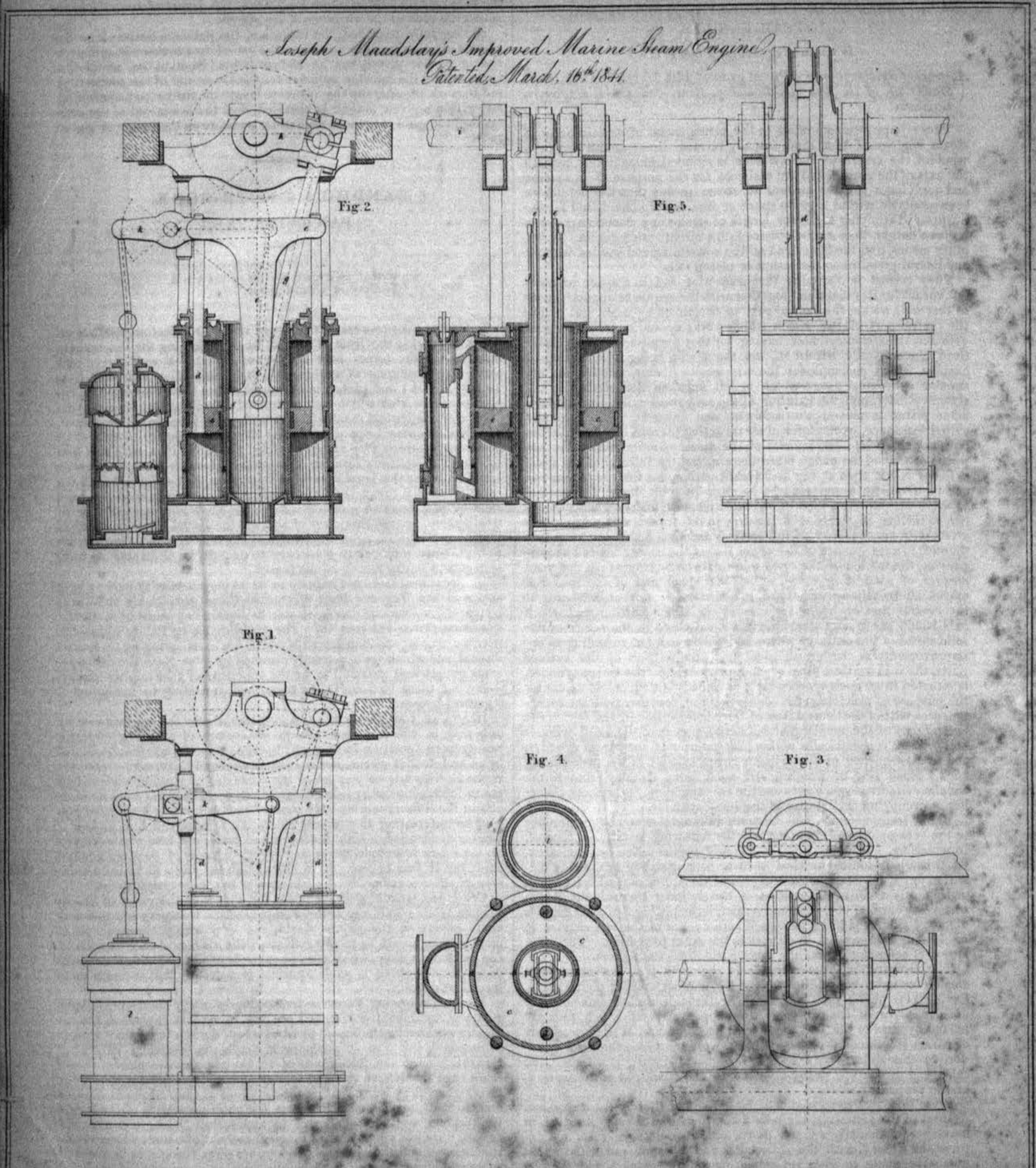
Books received which must stand over for notice until next month—Elements of Perspective Drawing; Report on Boucherie's Process of Preserving Wood; Denton's Outline of a Method of Model Mapping; A Letter to the Shareholders of the Bristol and Exeter Railway, by W. Gravatt, C.E., F.R.S.; this letter discloses some suspicious circumstances, which we hope before our next publication appears, the parties concerned will be able to clear up.

We regret that we have not been able to find room for a very valuable report on the Improvement of Lough Erne, by Mr. Rhodes, E.C.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.



J. R. Jobbins, Warwick Ct

IMPROVEMENTS IN THE CONSTRUCTION OF MARINE STEAM ENGINES.

(With an Engraving, Plate VIII.)

Abstract of Specification of a Patent granted 16th March, 1841, to Joseph Maudslay, of the firm of Maudslay, Sons, and Field, Engineers, Lambeth.

These improvements relate to the arrangement of certain parts of steam engines of that kind, (usually termed direct action engines), whereof the centre of the cylinder is situated immediately beneath the axis of the cranks, and are assigned for the purpose of producing and applying a greater amount of steam power than has heretofore been available within a given space or area on ship board, and for the purpose of applying a greater length of stroke and connecting rod in a given height, than can be obtained (in a direct action engine) by any other means, and the lower end of the connecting rod guided without any lateral pressure on the piston or piston rods.

They consist in disposing the connecting rod in a space which is left vacant for its reception, (together with the requisite appurtenances of that rod) within the central part of the steam cylinder, and within the central part of the piston which works up and down in the said cylinder, the steam cylinder having for that purpose a small cylinder fixed concentrically within it, and the piston being a broad ring or annulus, which encompasses the said small cylinder, and fits into the annular cylindrical space which is left between the interior of the steam cylinder, and the exterior of the said small cylinder. The annular piston is moved alternately up and down in the said annular cylindrical space, by the force of steam acting therein, but which steam does not enter into the interior of the small cylinder, neither is any piston or part of the piston fitted therein, but the interior of the small cylinder is left open at top and vacant within, for the connecting rod and its requisite appurtenances to work in, with liberty for that rod to move up and down therein, and likewise with liberty when so moving, to incline as much as it requires to do, from a vertical position alternately on one side of the vertical and then on the contrary side thereof, in consequence of the upper end of the connecting rod accompanying the motion of the crank pin in its circular orbit (in the usual manner of connecting rods), whilst the lower end of the said rod moves alternately up and down in a vertical line, that line being at the central line or imaginary axis of the steam cylinder, and which axis would in ordinary steam engines be situated in the centre of the solid metal of the ordinary piston and piston rod, but according to my improvements in the arrangement and combination of the various parts, the said vertical line or imaginary axis of the steam cylinder, is situated in an open space which, as already stated, is left vacant for the purpose of receiving the connecting rod, together with its appurtenances within the central part of the steam cylinder, and within the central part of the annular piston, in consequence of the small cylinder being fixed concentrically within the interior of the steam cylinder, and in consequence of the cylinder cover, as well as the piston being each a broad ring or annulus, and each being suitably fitted to the annular cylindrical space between the two cylinders, but without covering or occupying the interior of the small cylinder.

These improvements will be more fully understood by a reference to the accompanying engraving, and the following description thereof, in which fig. 1 is an elevation of the said engine taken longitudinally, fig. 2 is a longitudinal vertical section corresponding to the side elevation fig. 1, fig. 3 is a horizontal plan of the upper part of the engine, and fig. 4 is a horizontal section of the cylinder thereof; fig. 5 is a transverse vertical elevation and section representing two such engines disposed side by side for combined action; one of the two engines in fig. 5 being represented in elevation, the other in section. The same letters of reference denote the same parts in all the figures.

The exterior or large cylinder is shown at *a a*, the interior and smaller cylinder concentric to it at *b b*, and an annular piston at *c c*, having two piston rods *d d*, working through stuffing boxes in the annular cover of the cylinders, the upper ends of which rods are affixed by keys to the T shaped cross head *e, e, e, e*, at the lower ends of which cross head there is a slider *f*, working within the inner cylinder, to this slider *f* one end of a connecting rod *g* is attached, the other end of the rod being attached to the crank pin of the crank *h*, on the propelling shaft.

From this arrangement it will be perceived that by the ascent and descent of the piston *c c*, the rods *d d*, will cause the cross head *e e*, to move perpendicularly up and down, and in so doing to raise and depress the slider *f*, with the connecting rod *g*, which rod will by that means be made to give rotary motion to the crank *h*, and thereby cause the paddle-wheel shaft *i* to revolve. The rods *j j*, connected to the slider *f*, will at the same time work the levers or beams *k k*, to which the rods of the air pump *l*, are attached.

Having fully described the invention, the patentee desires it to be understood that he does not claim the use of two concentric cylinders and an annular piston, but he claims as his invention the use of the space within the interior cylinder for the lower end of the connecting rod to work in, whereby the ultimate length of stroke and connecting rod within a given height is obtained, and the lower end of the connecting rod guided without any lateral pressure on the piston or piston rods.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXXII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. One of the prettiest little bits of street architecture about town that I know of is the front of a small house adjoining the Polytechnic Institute, in the upper part of Regent Street;—a very clever and artist like specimen of Italian, in which rustication of a more than usually finished and picturesque character has been very happily applied—of that kind which may be termed *mixed* rustication, both vermiculated rustics and moulded ones with plain faces being employed, —as has likewise been done in the new houses on the south side of Lowndes Square. The character thus produced is at once rich and sober. The archway forming the entrance to some livery stables, on one side, is not the least agreeable feature in the design, nor is it any compliment to it to say, that it is in infinitely better taste than the huge slice of architectural gingerbread which Nash clapped by way of frontispiece, against that mass of ugliness the Royal Mews at Pimlico. How that Nash did palm his Brummagem stuff upon old George the Fourth!—and took pretty good care to be paid for it in sterling cash —good and lawful money of the realm!

II. Because it does not happen to be as big, as tawdry, and as ugly as one of the Regent's Park Barracks—those genteel Union Workhouse affairs—no one has been able to discern any merit at all in the specimen above referred to. The Paddington or Paddy style—the horrible mushroom monstrosities which are now springing up in that district, and which are apparently directed by some Nash the second—some genius well qualified to be the successor of that mighty master, —are far more to John Bull's taste, and according to his notion of "genteel houses."

III. "Can you give me any sure general rule for my guidance by adhering to which I shall always be certain of attaining superior beauty in composition and design?"—Such was the question once put by an architect to a connoisseur of acknowledged taste, who thereupon replied: "My advice was asked the other day by a writer who wished me to inform him what rule he should attend to in order to raise himself in the literary world. My counsel to him was: be original if you can, be interesting if you are able. As I answered him, so now I answer you: display both invention and taste, and into whatever you do take care to put character and effect. I know of no other general rule; but if you can act up to that, I believe you will find it a sufficiently efficacious one." A plain answer to a very *simple* question!

IV. It is a wonder that Pugin has not shown up the range of Brummagem Gothic buildings in the Temple,—most trumpery and tasteless as to character, though, no doubt, not very trumpery—perhaps of most sterling merit, as to cost. Not a little strange, too, is it that he did not have a fling at that notable example of Civic Gothic the façade of Guildhall, which is such a perfect monstrosity that it deserves to be pulled down.

V. Besides giving Turner a tremendously heavy blow—one almost sufficient to demolish him, and put him quite *hors de combat*, the reviewer of the "Exhibitions," in Blackwood, deals a few home strokes at Stanfield, and also at our present English view-mania. "What," he asks, "must the inhabitants of all the tumbledown places on the Rhine and the Rhone think of us, our scenery, our buildings, and our taste, when they learn that representations of their beggarly edifices and their abominable outskirts form the chief ornaments of our Royal Exhibition?"—"Nor in respect to architecture," he afterwards observes, "are our views always in good taste. The low and the mean, the decayed and the poverty-stricken, are often thought to be the only picturesque, as if *picture* must indulge in vile associations. Let not art take *habitat* in "rotten rows," nor vainly imagine that the eye should

seek delight where the foot would not willingly tread—the purlieus of misery and vice. All the pictorial charms of light and shade, and colour are to be found in subjects which shall not degrade them. There is no lack of architecture that elevates instead of depressing the mind, both by its grandeur of design, the work of genius, and by the associations it calls up. In a word, in every branch of art let what is low and mean be discarded, however it may tempt the artist under the idea of the picturesque."—To the above advice which is very much needed, might be added another wholesome caution—namely, that in subjects more or less professedly architectural, the architecture itself should be treated as principal—as that in which the main interest lies, and not as too frequently happens, exhibited little more than nominally being nearly slurred over, while the value of the composition is made to depend upon accessories and casual circumstances—perhaps on *staffage* and figures, or some exaggerated contrast of light and shade, improbable if not impossible,—a pyebald medley of midday and midnight. As to architectural character, whether arising from the ensemble or the detail, that is not to be looked for in the "illustrations" annually manufactured to suit the taste of the million. We have views of Windsor Castle, wherein the building itself shows itself only as a mere speck in the landscape, the real view being that of trees and cattle, or figures in the foreground. In many cases, indeed, such mode of representing and "illustrating" buildings is not only highly convenient, but suitable and advantageous also, the things themselves being of no interest, or at all worth being shown. This may be affirmed of almost the greater part of topographical illustrations—views of the most insipid and common place houses, &c. imaginable, "of no value except to their owners."

VI. One might almost imagine that scarcely a building of any note had been erected in Germany within the last five and twenty years,—that Berlin, Potsdam, Munich, Dresden, Vienna, Hamburgh, &c. could not boast of a single new architectural feature of any merit, that Schinkel, Klenze, Gärtner, Moller, Gutensohn, Ohlmuller, Semper, &c. had executed nothing—nothing at least deserving the attention of the English public. How else are we to explain the neglect which modern German architecture has experienced from those who set themselves up as luminaries of taste, to enlighten the public, and to "illustrate" by their pencils the *notabilia* of other countries?—Our consolation must be that perhaps we lose very little by such subjects as those above alluded to being passed by unnoticed by our manufacturers of views and "illustrations,"—things for the most part made up from slovenly, hurried sketches, which the engraver is left to make out as well as he can, and to dress up to the best of his ability. What such productions want in regard to truth and fidelity, is amply made up for by imagination and invention,—which have ever been reckoned among the more valuable qualities of art. Besides which there is one very great advantage attending the disregard of truth-telling accuracy, which is, that it does not forestal the gratification to be derived from viewing the buildings and places themselves, since they are generally found to be altogether different from their pretended representations. Thus when seen they make all the impression of perfect novelty, and produce double surprise—agreeable surprise at finding them greatly surpass expectation, and a queerish, indiscribable sort of surprise at finding out how much we have been all along *mist*-ified by owlish illustrators.

VII. After seeing to-day the works at the New Houses of Parliament I feel most amiably disposed towards Mrs. Wright of "awful conflagration" celebrity—whom I once, I believe, called a stupid old Jessabel worthy of the pillory, for had she by timely interference prevented the "accident," the splendid pile now rising to view would never have been reared. It was a mercy that the old "Houses" were burnt down when they were; since had the fire occurred during the "reign" of James—that is, the reign of James Wyatt "of execrable memory,"—we should have had some strange Gothicizings, such as those which now strike us with astonishment in some of the buildings still remaining in what was formerly the river front. The great fault of Mr. Barry's Gothic is that it puts us quite out of conceit with a good many other things, and with Windsor Castle among the rest; which I must confess falls greatly short of what I had been previously led to expect, there being very much in it that is exceedingly questionable as to taste. Not the least remarkable circumstance in Barry's edifices is that the inner courts—the quadrangle of the Speaker's residence, for instance, will be though less elaborate as carefully designed and finished as those parts which are exposed to public view; whereas the greater part of the exterior of the British Museum presents only a mass of plain brick wall, with naked windows. I admit that more attention is paid to design in the inner court of that edifice,—and wonderfully frigid it is—classically dull and Smirkish throughout. Poor Smirke! how greatly he is to be pitied!—and for the very reason that many may now envy him, to wit, because he has had so many opportunities of manifesting his imbecillity. Barry—Smirke, they are as far asunder as the two poles; or I might say the difference between them is that of the tropical and the frozen regions. As to Barry, I am afraid that his Houses of Parliament will sadly discomfort Welby Pugin, by giving the lie direct to his assertions.

VIII. "One of the Ventilation Folks" has taken too much *au pied de la lettre*, the obviously quizzical remarks in which I indulged in regard to the excessive and *fussy* rout on the subject of ventilation, as if it was a perfectly new discovery, and as if people had been suffocating themselves for ages past, rich and poor alike, in palaces as well as in hovels, in the country as well as in towns, and inhaling pestilence at every breath, at least when within doors. Nothing as far as I can discover, did I say in favour of stinking alleys, and frowsy rooms; nor did I express any admiration for the *aroma* of a drain, though from what the "One" has said it might almost be fancied that I recommended it as "a cheap and elegant substitute" for attar of roses. My remarks went no further than a little banter on the overstrained necessity for far greater attention to ventilation than has hitherto been considered requisite, except for prisons, factories, and other buildings where people are densely pent up together. That the doctrine of the Ventilation Folks is somewhat overstrained can hardly, I think, be denied; for the plain reason that it proves rather too much, and that a great portion of the population in towns could hardly exist at all; nevertheless exist they do, and that, too, under circumstances which must frequently aggravate a thousandfold the mischiefs arising from insufficient ventilation.

If ventilation be of such exceeding importance as is insisted upon by its advocates, how terribly—nay fatally must those people blunder who take their daily airing in a carriage with the windows drawn up, and which is then nearly air-tight. Not less blundering is the practice of those who make it a point to secure an airy bedchamber, and then closet themselves within curtains drawn so closely around them, that they might as well sleep in a closet of the same dimensions as their bed. If "Ventilation" be quite in the right, Gentility must be confoundedly in the wrong; since what barbarians those must be who in order to gratify a little trumpery vanity, stow away and squeeze their "five hundred dear friends" together, till they might nearly as well be in the Black Hole at Calcutta! Why do not the Ventilation Folks call upon the legislature to make all such "At Homes" illegal assemblages, devised for the purpose of smothering her Majesty's loyal and fashionable subjects? I know not whether the Ventilation Folks are particularly musical, but if they are so at all, I presume that their chief and favourite instrument is the Æolian harp; at the same time I suspect that some of them have no particular dislike to playing the *trumpet*.

HINTS ON ARCHITECTURAL CRITICISM.—PART 2.

My last paper confined itself to a statement that architecture possessed the same claims to open criticism as her sister arts;—my present design is to enforce those claims more strongly. The attempt then was to deprive taste of its precarious nature, and so to shake prejudice, as to prepare the mind for further illustration in proof of that statement; the present effort consists in reconciling an apparent discrepancy between the claims of architecture and the other arts, by displaying the peculiar features in which her poetry is cast, and by showing that though the mind be effected in a more remote and delicate manner, and that though an emotion, or an idea induced by it, be neither so animated, nor so vivid as another art might produce, yet that its effects are not the less faithful, nor less the result of a principle (whilst the principle itself emanates from nature); and hence, that if there be such a principle to guide the architect towards the material of his fancy, then architecture may remodel herself, and criticism may unbend.

One peculiar distinction of architecture appears to be in its compelling us when viewing the composition, to assume a suggestive or comparing attitude, and this necessity is consequent upon there being little that is strictly imitative in its phisiognomy or shape. This power of suggestion varies in degree, in the choice of features, and in the manner of their disposal. Where there is an introduction and classification of natural figures, so as to intrude on the province of the sculptor, the suggestive power of the art is shown in its faintest degree, for the imagination is in that case assisted by the presence of a familiar object, and the senses being palpably impressed, the mind has less effort to arrive at the final conception and emotion. The suggestive power in this case however still belongs to architecture, because it forms a feature in the whole, and because the architect exercises a discretionary power in the adaptation; but the features themselves are not so strictly suggestive as architectural features usually are

The strictly suggestive character is, where the object has no counterpart in nature, but where, from a certain attitude or proportion in the figure, assisted by relative position, the mind is left to suggest to itself an object in nature, expressive of some ideal quality, to which the figure might claim a point or two of resemblance.

In the comparison between the figure which has no counterpart in nature, and that which the imagination furnishes, there is extreme delicacy of perception requisite to detect a similitude; for, in exercising this power of comparison, we but transpose the elements of wit, since the strength of wit which consists in its delicacy is but the perception of a certain resemblance between two things, not essentially similar, but alike only in those features of which the idea takes cognizance. Two ideas in this case present themselves, and the relation found in those ideas, after the test of comparison, is essentially the product of wit. The relish which the mind has for this ingenious activity, the natural bias there is apparent in most of us, to indulge in this harmless intricacy of thought,—the pleasure too which we experience in detecting the force of an allusion, all imply an innate power in the mind to perceive a possible harmony or relationship between two separate and distinct things. It is in fact a self creative power, which for the time the mind exercises, by which out of apparently inapt materials, it shapes a perfect idea. Applying this to architecture, we may at once perceive the origin of the claim, which its inanimate features have upon us. Further to examine into the principle which moves us, we may perceive, that in the comparison of wit, however varied the play of fancy, or however apportioned the strength of perception may be, the ideas placed in juxtaposition, are not seen directly in the attribute of an object, but in that which is mostly associated with that attribute,—viz. the attitude or position by which we judge of the mind or intention. It is the external sign which wit first embraces, and not the inward evidence, and hence it is we comprehend the force of the ludicrous, (which is in truth the force of unexpressed wit) from figure, attitude, &c., our idea of pleasure arising from conflicting associations,—that is, from certain real or declared properties of the object, or of the mind through the object being seen connected with associations, which we perceive totally at variance with those naturally connected with them. It is upon this ground that we smile at the large head of a dwarf, or at the affectation of delicacy in a fat person, or laugh at the threatening attitude of a little slender man: therefore the pleasure of comparison is the pleasure of attitude; and inasmuch as this pleasure may be carried from wit to poetry, a definition of the poetry of attitude is necessary to assist in supporting the poetry of architecture.

The attitude of an object affects us then because we observe certain dispositions of the mind when exhibited, are frequently associated with certain attitudes, which, when unstudied appear natural, until from frequent observation that the same attitude is an index to the same disposition of the mind, we identify that attitude with it. It is this which has given personification to still life, and peopled nature with living beauty and grandeur. It is this same principle which has associated the willow with grief, and the oak with stubborn dignity;—which has detected modesty in a flower, or discovered wanton beauty in moving foliage. It is in truth the principle of life to the art of the poet, and it is by this that the poet is understood. The spectator of nature admits this in his own emotions, as he watches those objects which surround him, for he sees the graphic power of scenic poetry to consist in its picture of attitudes. The poet admits its influence still more delicately when he allows an attitude to invisible things. It was a consciousness of the poetry of attitude, that induced the lines:

> "'Tis sweet to listen as the night winds creep
> From leaf to leaf."

For whilst the ear is made sensible of the approach of the winds, the eye also may observe their furtive melancholy progress. It is thus then that attitude engages us, but attitude is not always significant of a collected state of mind;—there is often a carelessness about it which induces a different emotion from that attitude, which directly expresses an idea: it being always borne in mind that the object is for a time the personification of feeling and of will. A similar kind of effect is produced on the mind in such a case, only very faintly,—there being no definable idea connected therewith. It is very frequently the case in architecture that we feel the truth of this, as we revel amidst the smaller attractions of a composition, where we perceive about its minutiæ, attitudes, which we think beautiful, without knowing why. This innocent perplexity of thought which assails the mind, leaving it only when it has bewildered it, is the very secret of all the interest created: the reason being tempted into innumerable petty defeats, from each of which it arises to encounter a fresh one, as the several parts of beauty appear to seduce it on. It is here that criticism is disarmed,—criticism taking cognizance only of the position and extent of such attraction; and, it is because criticism is disarmed at this point, that architecture often exhibits such redundancy of beauty, which sickens the fancy and the taste. Attitude however has its carelessness, in a nearer approach than this to individual beauty, that is, where there is a more definite proportion traceable through its parts, though the same perplexity of the mind may be preserved; and it is in this state of attitude that we discover the beautiful in architecture, and by this are enabled to depict its ideal of grace or of grandeur. Byron beautifully illustrates this thought in his description of Dudù:

> Few angles were there in her form, 'tis true,
> Thinner she might have been and yet scarce lose;
> Yet, after all, 'twould puzzle to say where
> It would not spoil some separate charm to pare.
> She looked ————
> The mortal and the marble still at strife,
> And timidly expanding into life.

Admiration of women in general, springs from the same subtle and exquisite cause: our ideas moving like the movements of sense amidst the same perplexities, becoming as we gaze, like the lovely cause, an elegant deceit. For to admire woman requires not that we be absorbed by her mind, or her acquirements, since to appreciate either, we must turn to the cold test of a balance, or a criticism: nor do we descend to the base notion that she is the mere adjunct of pleasure, since poetry, the very element of her charms must then decay. No!—we seek her as a riddle,—we love her as an enigma,—we chase her through the follies of her course as a lovely inconsistency,—as a fanciful light we would snatch at and grasp. Our vanity tempts us to seize this for ourselves, which nothing seems to arrest, and to hug this creature of caresses, if only to rob nature of her dearest child.

Our ideas of grace and grandeur in architecture becoming then often those of attitude, as do those of the beautiful and sublime in nature,—grace, which we identify with no particular proportion when discovered in nature, becomes at once in attitude a lovely perplexity,—a creature of careless, yet correct shape, which, at a motion however slight, would take another form of elegance, as beautiful as she herself would be unconscious. Grandeur differs from grace, inasmuch as the energetic differs from the wanton, so that grandeur is always the creature of comparison, whose colossal form suggesting powers, contrasts itself with familiar trifles.

The principle which affects us has already been shown, but looking at this in a simpler and more homely guise, we may say that it is the poetry of attitude, which is the poetry of arrangement;—that is displays itself in domestic taste, and gives to the taste of a woman, that elegance and beauty so peculiarly her own. It is because her mind can engage itself in such gentle and beautiful comparisons,—because her perception of things is but a perception of their poetry,—because (which is a consequence) she allows nothing, and admits nothing around her, but such as can echo to her sensitively graceful mind, that her abode is replete with harmony, and beauty, and love.

Such is a feeble definition of the poetry of attitude, which is universal throughout nature, whether exhibited in her minuteness or her vastness, and such is a scanty description of that subtle faculty which extracts from her ever varying flowers, that honey which it hives for the nourishment of art.

Laboured as such reasoning may appear, inapplicable as such abstract considerations may be thought to the practical requirements of art, there is nevertheless in such an analysis, the exposure of poetry in its germ. There is, in testing our sensations by the varieties of nature, that secret spring opened into activity, which enriches the productions of art, and causes beauty, grace and grandeur, to start from the inanimate stone. There is, in generalizing our views, a liberality given to the mind, which deducing out of its observations, the true principles which affect it, begets an intuitive confidence in its own powers, to conceive and embody for the eye, its ever beauteous—ever endless creations. The deduction from the argument is, that if nature be the poet's laboratory, and if attitude prove to the mind one of her most operative principles, then, the degree of poetry in architecture bears a ratio (as far as attitude is concerned) to her power over attitude. It has already been shown by inference that she has this display of attitude, and that she embraces the same materials of beauty, which we see in external nature, therefore, as children of nature, we assert the poetry of our art. We know too that she has the same scenic effects from the lights and shadows she distributes; for when, as in the cathedral, these fall softly on surrounding objects, or when the eye sinks wearied from its awful wanderings amidst vastness and obscurity, to repose amidst beauties which peep from the dimest perspective, chords of joy swept by attitude vibrate on to entrance the senses.

So much for the principle which moves us, and so much for the argument in favour of architecture and her claims to criticism: yet, it

must be borne in mind, that no more is attempted than to show a principle;—all illustration being consequent upon, and not connected with it;—the present attempt being solely to establish a claim to criticism, and not to dilate upon what it would be premature to consider, when attitude itself is merely subsidiary.

Space prevents further pursuance of a subject which would lead us away from attitude, to proportion, the questionable nature of which it was designed to sketch. Not wishing however to intrude further before the reader, the conclusion is reserved.* However humbly these hints are delivered, or however feebly they may have been conceived, the writer knows that nature is adequate to the profoundest investigations, supplying as she does to every art the truest and the wisest rules, and that the more closely we adhere to her unchangeable maxims, the more dignified do we rise as artists, and as lovers of truth. He knows also that unless an art be capable of charming the senses, or of enriching, or of delighting the imagination, and can support its claims to such power, it is only a mockery of commendation to say that its compositions are governed by the most exact rules, and hence it is only a mockery to criticize:—"*ars enim, cùm à naturâ profecta sit, nisi naturam moveat ac delectet, nihil sane egrisse videtur*:"—Cic. de oratore.

FREDERICK EAST.

October, 1841.

ENGINEERING WORKS OF THE ANCIENTS, No. 10.

THE present paper, which will be devoted to the Latin authors, will conclude this series, which, although far from being complete, is extensive enough to show that much may be done to illustrate the antiquities of engineering. C. J. Cæsar is the first author who comes before us, and in him we find nothing except an allusion to the mining skill of the Gauls, and an account, in Book 4, ch. 15, of the bridge he threw over the Rhine. In Sallust we find absolutely nothing. From Livy the gleanings are but few, an allusion to the works of the Tarquins in the first book; in the ninth book a statement that Appius Claudius Censor executed the Claudian aqueduct and Appian way; in book 39, a similar mention of C. Flaminius; in the 100th book, which is lost, there was an account of the drainage of the Pontine marshes. Quintus Curtius, in his 4th Book, ch. 2, has a long account of the siege of Tyre, and in Book 5, ch. 2, a description of Babylon. From Paterculus we have not been able to gain any thing, and Vitruvius we have left to the architects.

PLINY.

Pliny the Elder, who died A.D. 79, is to us one of the most interesting writers, for including in his work every department of the organic and inorganic world, we could scarcely fail to discover something of his value. We had occasion, however, last month to refer, in the review of Mr. Aikin's work, to some of Pliny's remarks on bricks, so that we are precluded from now giving them; the mining portion, we have also felt it necessary to exclude

BUILDINGS IN EARTHQUAKE COUNTRIES.

Pliny Book 2, ch. 82, recommends several modes of construction as calculated to resist the effects of earthquakes; he says that in some cases deep wells are advantageous, as they allow the dangerous gases to escape; that in some towns where there are many underground sewers, earthquakes are less felt; and that building on piles is extremely effective, as was to be observed in Naples, where the most solid part of the town is that which has suffered most. Brick walls, he also thinks, are less injured than others.

TUSCANS—ISTHMUS, &c.

In the 3rd Book, ch. 16, our author says that the Tuscans were the first to begin the canal system of the Po, by improving the Sagis. In Book 4, ch. 4, it is mentioned that King Demetrius, and the Emperors Julius Cæsar, Caius and Domitius Nero tried to cut a canal through the isthmus of Corinth but failed. In Book 31, ch. 3, is given a long treatise on wells, and chap. 6, on conduits.

INVENTORS.

Euryalus and Hyperbius, two brethren at Athens, caused the first brick and tile kilns, yea and houses thereof to be made in Greece. Gellius is of opinion that Doxius, the son of Cœlus, invented the first houses that were made of earth and clay, taking his patterns from swallows and martens' nests. Cingra the son of Agriopa, first devised tiling and slating houses, as also found out the brass mines, both in the island of Cyprus, he also invented pincers, hammers, levers, and the anvil. Danaus sank the first wells in Greece at Argos. Cadmus at Thebes found out stone quarries first. Thraso was the first builder of town walls, towers and fortresses, according to some, but according to others the Cyclops and Tyrinthians. Lydus, the Scythian, or Delas the Phrygian, taught the art of casting and melting brass, and of tempering it, and the Chalypes or the Cyclops invented the forge and furnace for brass. Erichthonius or Æacus discovered the silver mines of Attica, and Cadmus, the Phenician, the gold mines of Mount Pangæus, and the mode of working and melting that metal, although by some it is attributed to Thoas and Æaclis in Panchaia, or to Sol the son of Ocean. Midacritus was the first who brought lead (query tin) from the island Cassiteris. The iron-smith's forge was first invented by the Cyclops. Coræbus, an Athenian, taught the art of casting earthen vessels in moulds. The weaver's spindle was invented by Closter, son of Arachne; the potter's wheel by Anacharsis the Scythian, or Hyperbios the Corinthian; carpentry, and carpenter's tools, as the saw, chipaxe, plane, hatchet, plumb-line, augre, gimlet, as also glue by Dedalus; and the rule and square, the level, the lathe and the key by Theodore the Samian. Pyrodes, son of Cilix, found out the way of striking fire from flints, and Prometheus the means of keeping it in a wick of the *ferula* or giant fennel stalk. Instruments of warfare and vessels of war owed their origin to many hands, but to the Syrians is attributed the catapult, to the Phenicians the balista, and to Epeus at Troy the ram. (Book 7, chap. 56.)

METALS.

In the 33rd book Pliny begins his discourse on metals, minerals and mining, this is continued in the 34th.

CEMENTS, BRICKS, &c.

It is in the 35th book that our author discusses the subject of pottery. He says that a means had been found out to make a strong kind of mortar or cement with the broken sherds of potters, if the same be ground into powder and tempered with lime, this is called Signina, and durable pavements are made in the same way. Puzzolana is next described, and other earths used for hydraulic cements as those of Cyzicum, Cassandria, Gnidos, Aulis, the Nile, &c. Afterwards came the several kinds of mud walls, pisee work, rubble, &c., and the several forms of bricks.

The 35th Book is descriptive of stones, marbles, &c., where it is said that Ethiopian and Indian sand was used in cutting marble. This Book also treats upon limes, mortars and pavements.

In thus concluding our labours on this subject, we trust that we may indulge a hope that we have not laboured in vain; it was our endeavour to show that engineering was no art or science of to-day, but one of the remotest antiquity, long practised and long honoured, and if in so doing we have in degree vindicated the claims of the engineering profession to distinction, we shall consider our exertions fully repaid. We may say with truth, that however trifling the result, they have cost us much research, long time, and the perusal of many volumes, which, as they rarely come under the student's inspection, so has he little time to devote to their perusal.

A NEW SAFETY VALVE.

SIR—If you consider the following worthy of insertion, you would much oblige by giving it a corner in your valuable Journal. It being well known that a compound bar of steel and brass will, on account of their different rates of expansion, assume a curved form on the application of heat, which property I propose to apply to a new safety-valve by the following means:—I would place such a compound bar in a curved form into a cylinder open at each end, having four arms radiating to its centre through which passes a rod fixed to the cylinder, and which carries at the other end a circular plate moving steam tight, of a fixed plate perforated with two or three holes for the escape of steam. Then the bar being set, so that the apertures in the fixed plate shall be covered at the proper working pressure of the steam, then if the temperature should by any means be raised, the bar will immediately cause the rod to turn and open the valve.

There are many mechanical details that are not mentioned, wishing only to set forth the principle.

I am, Sir,
&c. &c.

18th Oct.

FUNNEL.

Vienna.—"The Austrian government," says a letter from Vienna of the 16th of September, "has formed the gigantic plan of building at the eastern extremity of this capital, on ground which is wholly unproductive, a new town, capable of containing 50,000 inhabitants, and which is to be provided at the outset with all the requisite great public buildings, such as churches, residence of the governor, court of justice, exchange, theatres, museum, &c. This town is to be called "Ferdinandstadt." The plans are already made by the Chevalier Forster, architect of the Court, who before he submits them to the government, intends to communicate them to the principal academies of the fine arts in Europe, with a request to give their opinion."

MR. STEVENSON'S IMPROVEMENTS ON LEVELLING INSTRUMENTS.

Sir—In the minutes of the Institution of Civil Engineers which were published in last month's Journal, there was a notice of my improvements on levelling instruments; but that notice was not correctly given, and strangely enough omitted all mention of *two* of these improvements. I have therefore as a favour to request that you will give the following correct account of these improvements a place in your Journal, which may be considered to be the present acknowledged organ of the profession.

Levelling Staff.—The improvements on the levelling staff is as follows: the first is the introduction into the staff with sliding vane of an adjusting screw with clamp, by which, after the vane has been brought within ¼ or ⅛ inch of being correct (which is readily done with the hand), the vane is firmly clamped, and the final adjustment up or down is at once made with the screw. A similar plan, I have since been informed by Mr. Manby, Secretary to the Institution of Civil Engineers, was used by Capt. Lloyd (Roy. Soc. Trans.), and also by Mr. Bunt, while prosecuting their scientific researches; but Capt. Lloyd's staff was only 6 ft. long, and Mr. Bunt's 9 ft., being too short for engineering use. The application of this arrangement to engineering purposes I have found of great utility. The above adjusting apparatus is for the vane when on the lower half of the rod, which is 12½ ft. long. But when the level line (*i. e.* the optical axis of the telescope produced) is above the lower half of the staff, the vane is as in all rods with sliding vanes, first clamped at the top of the upper half of the staff, which is then pushed or slid along the face of the lower half, until the vane is within ¼ or ⅛ inch of being correct, when the *upper half of the rod* is clamped and finally adjusted up or down by a clamp and screw apparatus fixed at the back of the lower half. By this plan, although the vane may be far out of reach, the adjusting apparatus never moves, being a fixture and within reach of the hand, thus obviating the necessity of having a long adjusting wire fork for working a capstan-headed vane screw, which, although perfectly suitable for Mr. Bunt's *optimum* levelling would of course not answer the long rods used by engineers. The next improvement is *the combinations in one rod of all the advantages of the sliding vane staff, with vernier readings for accurate work, and the self-reading staff for rough work.* This is effected by having the back of the rod graduated to feet and decimals by means of inlaid bone figures which are read through the telescope level. In this way I have not lost sight of Mr. Gravatt's ingenious contrivance of self reading. In making a section where it is necessary, in order to carry forward a correct result, to be careful only with the first and last sights after and before moving the instrument, the intermediate sights are read off the back of the staff by the telescope. The above instrument, which is 12½ feet long, and may be said to consist of a sliding vane staff and a self-reading staff, is, by the contrivance of a late friend of mine, packed up in a box 3½ feet long and 4 inches square!

Level.—The first improvement in the level is the fixture to the telescope tube of a *circular level sluggish in its motions*, instead of the comparatively delicate cross bubble of Mr. Gravatt's level.

The last improvement is the introduction of a *ball and socket joint* between the head and legs of the instrument, so as to have a motion intermediate in fineness between that of the parallel plate screws and that of the legs. Before the introduction of the parallel plate screws, I understand that levels had a ball and socket motion instead of the screws. The present improvement consists in *restoring* the ball and socket for the *rough setting*, and at the same time *retaining* the parallel plate screws for the *final adjustment.* The clumsiness of the present arrangement consists in the instrument being at all dependent on the setting of the legs. With the instrument thus improved, the surveyor is made quite independent of the level of the ground where he sets the legs of his instrument, and may place them without regard to the inclination of the telescope to the horizon. Looking first to the circular level, and releasing the clamp of the ball and socket, he with one hand moves the head of the instrument till the bubble is in the centre of the circle, an operation which is done almost instantaneously. The socket screw is then clamped, and the telescope bubble is brought to the *absolute* level by a slight touch of the parallel plate screws. In this way the legs of the instrument need never be moved after the instrument has been placed on the ground, and the parallel plate screws have almost nothing to do, advantages which all who are accustomed to levelling will fully appreciate. I may mention that the price of altering my old level to the new form was 1*l.*, but I have no doubt that in future the charge may be less. That the above improvements are well worthy the attention of the profession I am fully assured, else I should not have brought them forward. My own experience on hundreds of occasions, as well as that of others, has placed any thing like doubt completely aside, and with the ball and socket joint I have been enabled on very many occasions lately to take in sights with one setting of the instrument, that would otherwise have required two, owing to very irregular and precipitous rocks, which did not afford sufficiently level rests for the legs to allow the bubble to be brought right.

I remain, Sir,
Your obedient servant,
Thomas Stevenson.

Little Ross Island Light House Works, Kirkcudbright.
Oct. 11, 1841.

ON THE ECONOMY OF FUEL IN LOCOMOTIVES CONSEQUENT TO EXPANSION AS PRODUCED BY THE COVER OF THE SLIDE VALVE.

Sir—The confidence of anonymous writers is sometimes exceedingly amusing. For reasons best known to themselves they seem to put but little value on the idea that they themselves may perhaps be labouring under misapprehension; and such is singularly the case of a gentleman signing himself M., the author of a letter in your October number, containing some strictures on a paper of mine in your August number, on the subject which is the title of this letter. This gentleman, Mr. M., having discovered, he says, some errors in my calculations, hopes you will allow him to point them out for the benefit of your readers; and he begins by premising that although some formulæ of mine, which he points out, are correct, yet in two of them there are expressions which are identical, and which, he says, might perhaps be better expressed, now whether or not these expressions are identical, any schoolboy can find out, and whether or not they are identical, I hope Mr. M. will have the generosity to allow me to suppose them better stated in the form I have adopted. Mr. M. now proceeds to state that the value of (*s*) (*s* being the area of the piston) is incorrect, and that it is impossible to deduce the area of the piston from the length of the stroke cover and lead of the slide, and ratio of the greatest to the least pressure of the cylinder, without knowing how much steam is generated in the boiler. If Mr. M. would have the goodness to read over again a part of my paper, he would find it there stated that in the mode of expansion virtually adopted in locomotives, the cylinders are enlarged so as to consume the same quantity of steam, (which is just the whole steam that the boiler can produce); and this is the only way in which the question of advantage from expansion can be treated; now if Mr. M. would consider for a little he would see that what I am about with the equation,

$s\left(a' - \frac{(2d-b)\,t}{p}\right) = 2d \times 1$ is finding what area the piston must have so that the steam may be cut off at (a'), and yet the same constant quantity of it consumed, and he would see that so far from being able to give (*s*) any value we please, it can on the contrary have only one definite and particular value, which is assigned by this equation, and so far from $2d \times 1$ being an arbitrary quantity, it is the very quantity that properly represents the quantity of steam produced by the boiler, or which is the same thing in the question under consideration, the volume that the cylinder would have if no expansion took place.

Mr. M. in the next paragraph leads me to doubt if he understands the mode of analysis it is necessary to follow in estimating the work performed by an engine working expansively, for the expression $\frac{a'p}{x} - t$ does not express the effective working pressure during the expansion, and only at that part of expansion where the piston is at a distance (x) from the beginning of the stroke; and how he has discovered that this gives the effective working pressure 3 or 4 lb. per square inch too much he does not mention, and I am unable to find out. Mr. M. mentions that I make no allowance either for the diminution of temperature of the steam during the expansion, or the waste space which has to be filled with steam. Perhaps Mr. M. for the benefit of your readers will be kind enough to tell us how much the temperature of the steam will be reduced in the hot climate of a locomotive's smoke box? Would Mr. M. seriously propose to introduce into this analysis the slight modification necessary for the waste space filled by the steam; which waste space varies in all locomotives, and will yet be reduced to almost nothing? Again, Mr. M. states that the effect during the part of the stroke from the opening of the eduction port the termination of the stroke, must not be neglected on account of the small opening of the port during that period, and that the pressure of the steam

is previously very little reduced by expansion. Mr. M. ought to have told us what degree of expansion he alludes to, as that altogether decides the extent of diminution of pressure by expansion, and when he considers that at this part of the stroke the motion of the piston is very slow, and the motion of the valve very quick, he will be able to see that the contemplated effect of this part of the stroke is considerable. Mr. M. next states that the effect of the compression of the educted steam is so small that it might be disregarded. I am sorry to see Mr. M. make such a remark, after having read the last paragraph of my paper, as the effect of this compression is altogether dependent on the extent of the cover and the lead.

Mr. M. in his concluding paragraphs has got into a sad maze, he supposes that I put the initial pressure of the steam in atmospheres equal to the area of the piston, and founding upon this most wonderful equation some beautiful deductions, he states that "these results show the manifest absurdity of the supposition." If Mr. M. would substitute for the letter (*s*) the figure (5), he would immediately be relieved from a multitude of his difficulties, and you are able to say whether the letter or the figure is in my paper. With the assistance of these remarks, perhaps Mr. M. will find out that the paper which he states requires "revision and correction" virtually less requires either than his own letter.

And I am, your obedient servant,

J. G. LAWRIE.

Cartsdyke Foundry, Greenock,
October 6, 1841.

SIR—I regret exceedingly that any expressions contained in my letter concerning Mr. Lawrie's communication on the Economy of Fuel in Locomotives consequent to Expansion as produced by the cover of the Slide-valve, and which you favoured with insertion in your Journal for this month, should have given that gentleman offence, as I perceive by his letter, which you were kind enough to send me for perusal, to have been the case. I therefore take the earliest opportunity of assuring him, through the medium of your columns, that such was perfectly unintentional, and also of acknowledging two errors into which I had fallen, though not altogether by my own fault, as I think I shall now show. In the first place I objected unjustly to his equation

$$s\left[a' - \frac{(2d-b)\,t}{p}\right] = 2d \times 1;$$

in which he merely stated (*s*) to be the area of the piston, having inadvertently omitted to mention at the same time that the area of piston required to use the same quantity of steam without expansion was considered as unity, so that (*s*) is not the absolute, but the relative area of the piston, or the ratio of its area when the steam is cut off after the piston has travelled a distance (a') to what it would be if the steam were not cut off at all; and I think Mr. Lawrie will allow that any other reader would be liable to be led into the same mistake as myself through this oversight on his part.

The second error which I have to acknowledge is the having attributed to Mr. Lawrie the absurd hypothesis that the safety valve be so loaded that (*p*) is equal to (*s*) (which he would have seen to be so printed in the Journal, if he had taken the trouble to refer to it before writing his letter), whereas I ought to have supposed it to be a misprint, as in fact it is, and I now see clearly that the (*s*) was intended by Mr. Lawrie for a (5).

I shall now endeavour to convince Mr. Lawrie that the rest of my remarks were not thrown out without due consideration.

First then, although a school boy might have been able to find out that the two expressions alluded to in the first part of my former communication were identical, if the problem had been proposed to him, yet I should very much doubt whether he would see it at a glance, without having any previous suspicion of the fact; but, having discovered it in the course of my investigation (for which discovery, however, I beg to be understood to claim no particular merit), I thought it would be useful to communicate it to your readers, since it saves the trouble of calculating the same quantity twice over by two different methods.

I have now to return to the equation already quoted above, in the second member of which the factor (1) expresses the area of the piston when there is no expansion, and (*s*) its area when the steam is cut off at (a'), the same quantity of steam being admitted during the stroke in both cases; and with this explanation I acknowledge the correctness of the above equation, except inasmuch as the waste space at the end of the cylinder, which has to be filled with steam as well as the length (a') of the cylinder, has been omitted in the account (and this Mr. Lawrie must excuse me from admitting to be *reduced to almost nothing*), and also inasmuch as the pressures (*p*) and (*t*) are used instead of the corresponding densities of the steam. The Count de Pambour, in his *Treatise on Locomotive Engines*, and *Theory of the Steam Engine*, assumes this waste space to be equal to $\frac{1}{20}$ of the contents of the cylinder within the limits of the stroke of the piston, and I believe this estimate to be, in all cases, rather below than above the truth. Besides, where is the necessity or advantage of neglecting that quantity, when there is no difficulty in taking account of it, at least by approximation? Its actual value may be employed, when known, otherwise by using an approximation such as $\frac{1}{20}$ a more correct result would be obtained than by omitting it altogether. The above equation, corrected for the waste space, and with the substitution of the densities (δ) and (δ') for the pressures (*p*) and (*t*) respectively, becomes

$$s\left[a' - \frac{(2d-b)}{\delta}\delta' + w\,\frac{\delta-\delta'}{\delta}\right] = 1 \times \left[2d + w\,\frac{\delta-\delta'}{\delta}\right],$$

whence

$$s = \frac{2d\,\delta + w\,(\delta-\delta')}{a'\,\delta - (2d-b)\,\delta' + w\,(\delta-\delta')};$$

where (*w*) expresses the length of a portion of the cylinder equal to the waste space at either end of it.

In order to show that the corrections which I have introduced, although not greatly affecting the result, amount notwithstanding to something appreciable, I shall presently apply them to one of the examples at the end of Mr. Lawrie's former communication; but it will be necessary first to make a further correction in the latter, which I shall do as soon as I have replied to the remaining paragraphs of his present letter.

With regard to my understanding the mode of analysis it is necessary to follow in estimating the work performed by an engine working expansively, I am sorry the want of perspicuity in my former letter was such as to create a doubt in Mr. Lawrie's mind, and I trust I shall now succeed in dispelling it; indeed the doubt has arisen from his assigning a more extended signification to an expression, which I used in common with himself, than the said expression had any right to bear, or was originally intended to bear by either of us. When I said that he found the *effective working pressure* during the expansion to be equal to $\frac{a'\,p}{x} - t$, I did not mean the *mean effective working pressure*, nor could I mean that that quantity, which so evidently varies with the value given to (x), could be supposed constant during the whole of the expansion, but precisely what Mr. Lawrie himself meant, viz., that it was the general expression of the *effective working pressure* during expansion, the particular value of which at any given instant would be found by substituting for (x) its value for the position of the piston at the given instant. This is, however, merely a misconception on the part of Mr. Lawrie, who no doubt thought my objection rested on the supposed difference which I have just explained away, whereas the real point at issue is whether the constant term (*t*) in the above expression faithfully represents the negative part of the effect, or the resistance of the waste steam on the back of the piston, or not. Now (*t*), as I stated in my former communication, is used by Mr. Lawrie to express the *lowest* pressure of the waste steam in the cylinder, which probably scarcely exceeds the pressure of the atmosphere, and he has likewise used it for the *mean* resistance of the waste steam, that is, the resistance due to the blast pipe added to the pressure of the atmosphere, during the whole of the portion (*b*) of the stroke. Now, according to the Count de Pambour's experiments, with the mean evaporation of locomotive boilers, and the size of orifice of the blast pipe commonly adopted, the mean resistance due to the blast pipe, when the velocity of the engine is 20 miles an hour, is 3½ lb. per square inch of the piston. In the description of Robert Stephenson's patent locomotive engine in the new edition of Tredgold on the Steam Engine, page 451, it is stated that that resistance is "6 lb. per square inch when running at the usual rate of 25 or 28 miles an hour," and that at greater velocities it "has been found to increase to double that amount, and even more." I think I am therefore fully borne out in the opinion that Mr. Lawrie's calculation makes the effective working pressure (I should have added, on the average) 3 or 4 lb. per square inch too much, if not more.

With respect to the diminution of temperature consequent on expansion, Mr. Lawrie must surely be aware of the possibility of reducing the temperature of elastic fluids, by sudden dilatation, many degrees below that of the surrounding bodies; but, since he wishes me to tell him how much the temperature will be reduced in the hot climate of a locomotive's smoke-box, I answer that, when the time given for expansion is excessively short, as it is in locomotives, this reduction is not sensibly affected by the climate, but depends on the primitive pressure and degree of expansion of the steam, and that in

his 3rd example, where the steam is (supposed to be) cut off at 5·2 inches from the commencement of the stroke, the diminution of temperature would, with that expansion, amount to about 80 degrees; but this is much greater than it would be in reality, on the hypotheses made by Mr. Lawrie, because the values found by him for (a') and (b) are so much too small as to exaggerate the expansion enormously; as an instance of which, in the example just quoted, these values ought to be 0·7726 and 0·9259 respectively, instead of 0·2884 and 0·7, and the steam would consequently be cut off at 13·9 inches, instead of 5·2, from the commencement of the stroke. This error, which runs through all 4 examples, and thus vitiates all the deductions, arose from Mr. Lawrie inadvertently changing the unity from the radius of the eccentric to the width of the port, in applying his formulæ.

Mr. Lawrie says that, when I objected to the omission of the effect of the steam during the part of the stroke from the opening of the eduction port to the termination of the stroke, I ought to have told you what degree of expansion I alluded to, as that altogether decides the extent of diminution of pressure by expansion. This is sufficient reason for not neglecting the quantity in question; for if there is any degree of expansion for which it ought not to be neglected, the only way to be sure of not doing so in that particular case is to include it in the general formula. However, I will take Mr. Lawrie's 2nd example, where the lead (on the steam side) is $\frac{1}{8}$ of the breadth of the port, and the cover (also on the steam side), $\frac{1}{2}$ breadth of port. Mr. Lawrie assumes that the valve has no cover on the eduction side of the port, which I think he will not find to be exactly the case; Mr. R. Stephenson allows $\frac{1}{16}$ inch on each side, and the ports are only 1 inch wide, which makes the cover on the eduction as well as the steam side of the port, $\frac{1}{16}$ of its width. It is obvious that this arrangement causes the eduction to commence later, by which means the pressure of the steam is not reduced so low at the end of the working stroke as it would otherwise be. It is, however, with the conditions assumed by Mr. Lawrie that I have calculated, at a great cost of time and labour, what the diminution of pressure would be in this example, from the opening of the eduction passage to the end of the stroke. I have supposed the initial pressure (before expansion) to be 5 atmospheres or 73·53 lb. per square inch, and the total area of the port $\frac{1}{10}$ that of the piston, and I have purposely made the reduction of pressure come to more, rather than less, than it would really amount to.

The radius of the eccentric, or $\frac{1}{2}$ the travel of the valve, which is called unity in the formulæ for calculating (a') (b) and (c'), is equal to the width of the port + the cover $= \frac{3}{2}$ width of port, whence the width of port $= \frac{2}{3}$, and $l = \frac{1}{12}$, $c = \frac{1}{3}$. With the aid of these values we find $a' = 0·8482$, $b = 0·9479$. Neglecting the waste space, the pressure is reduced by expansion to 65·07 lb. The eduction lead = the lead + the cover on the steam side $= \frac{5}{8}$ width of port, which is the extent of opening to eduction at the end of the stroke; and the crank is 26° 23′ 16″ from the dead centre when the port begins to open. This I have divided into intervals of 1°, and have computed the discharge of steam during each interval, supposing it due to the difference between the pressure *at the beginning of the interval* and the pressure of the atmosphere. This calculation is consequently very long, but I believe there is no formula yet discovered which gives the discharge during the whole time at once. I found in this manner that the pressure would be reduced at the end of the stroke to 52·87 lb., or 38·16 lb. above the atmosphere, which gives a mean pressure during the eduction lead of at least 44·26 lb. per square inch, or distributed through the whole length of the stroke, 2·31 lb. This, I think, Mr. Lawrie will not call *inconsiderable*; while the effect of compression would certainly not surpass, if equal, 0·4 lb. per square inch through the stroke, which I consider rather to be neglected than the former.

I shall conclude my letter with showing, as I stated above, that the corrections I introduced into the value of (s) are not altogether to be neglected, and for that I shall apply them to the example chosen above. By Mr. Lawrie's formula, we have

$$s = \frac{5}{4·241 - 1 + 0·9479} = 1·1936.$$

By the corrected formula, making $2\,d = 1$, $\delta' = 1$, $\delta = 4·3657$, $w = 0·05$, we have

$$s = \frac{4·3657 + 0·1683}{3·703 - 0·0521 + 0·1683} = 1·1872.$$

The difference is certainly not very considerable, being only about ½ per cent. on the required area; but why should even that correction be omitted, when it can be applied without any difficulty and with scarcely any additional trouble?

I am, Sir, your obedient servant,

M.

October 14, 1841.

CROSBY-PLACE, BISHOPSGATE STREET.

The committee appointed to superintend the restoration of this most interesting specimen of ancient domestic architecture appear to have brought their labours nearly to a close, and an inspection of the result of those labours will secure the praise of every lover of our architectural antiquities. It is highly gratifying to witness the timely preservation of a building which is "the only example of any magnitude of the halls and places of our forefathers in the metropolis, the numerous other buildings of this nature which once graced the city having fallen victims to the great fire, or the no less destructive hand of innovation. The reparation appears to have been carried forward as far as is desirable until the particular use to which the hall is to be hereafter applied shall be ascertained; and most fervently do we hope that it may be such as shall best accord with its present beauty and its past history. The new materials and workmanship harmonize so thoroughly with the original, as to render it impossible, except on the minutest inspection, to distinguish between the new and the old. The matchless beauty of the roof in the hall has been effectually preserved. This unique specimen of timber-work is remarkable for the skilful omission of ties and hammer-beams. It is divided into eight principal compartments in length, and four in breadth, the points of intersection being ornamented with light and graceful pendants, pierced with small niches, each pendant forming the centre of four arches, so that from whatever point it is viewed the eye is presented with a series of arches of elegant construction. The principal timbers are richly decorated with bosses of foliage, and "spring from octangular corbels of stone." It is remarked that the low pointed arch, approaching to an ellipse, is admirably calculated for the dissemination of sound. "The shafted oriel," notwithstanding all the rough usage to which it has been exposed, has recovered its pristine beauty, and, as well as the other windows, is "richly dight" with the stained glass armorial bearings of the former proprietors, and of the various companies and individuals of whose munificence the hall itself will be the lasting memorial. From some sources, of which we are ignorant, the council chamber and throne-room have been restored to a state of great beauty; not, indeed, on the same scale of magnificence as the hall, to which alone the public subscriptions have been devoted, but yet in a style perfectly in keeping with the age and character of the structure. When Crosby-place shall be transferred to the hands of its next possessors, these rooms will probably receive all those rich decorations which will enable them to vie with the splendour of a hall. It is, however, from its historical associations that Crosby-place must ever derive its greatest value and interest. In the reign of Edward IV., it was the magnificent home of Sir John Crosby, its reputed builder, who was here probably honoured with the presence of that Monarch whose cause had been so greatly strengthened by the zeal and prudence of his princely host. It is well known to have been afterwards the abode of Richard III.; Shakspeare has immortalized the fact, so that "Richard, Shakspeare, and Crosby-place, must ever be identified." Here Sir Bartholomew Read, Mayor of London, entertained a solemn embassy from Maximilian, Emperor of Germany, of which Lord Cassimir, Marquis of Brandenburg, his cousin, accompanied with a bishop, an earl, and a great number of gentlemen well-appareled, was principal embassador, which were triumphantly received in London, and were lodged at Crosby-place." Sir Thomas More, the witty and unfortunate author of the *Utopia*, when in favour, occupied Crosby-place, and afterwards sold it to "his dearest friend" Bouvisi, the Lucca merchant. In 1594, it was purchased by "the rich Spencer," who died possessed of nearly a million of money, and was an ancestor of the present Marquis of Northampton. Here he entertained no less a personage than the Duke of Sully, the Ambassador of Henry IV. of France. Among the sub-tenants in the early part of the 17th century, we find a name immortalized by Ben Jonson's most beautiful epitaph, "Sidney's sister, Pembroke's mother," and William Russell, probably a scion of the noble house of Bedford. In the disastrous period of the civil wars it was used as a prison for the Royalists; and in 1662, the Reverend Thomas Watson was the first ejected minister who officiated in the hall: he converted it into a Presbyterian meeting-house. He was followed by Stephen Charnock, Dr. Grosvenor, a pupil of Benjamin Keach, and Edmund Calamy, jun. The congregation continued to meet here till 1769, when it was dispersed, a farewell sermon being preached on the occasion by Mr. Jones, the predecessor of Dr. Collyer, at Peckham. The hall, as every one knows, became subsequently a common warehouse, and fell rapidly into a state of ruinous decay, from which degradation it has now, at length, been recovered. Thus, for nearly four centuries, has this beautiful structure remained, the witness of decent hospitality, of boisterous mirth, and of merry wassail; at one time its "rich embowed roof" and arras-covered walls echoing the

sweet music that arose from the minstrels' gallery; these walls then denuded of their costly draperies, and resounding with the groans and oaths of the Cavaliers, and once again consecrated by the solemn psalms and hymns of the Presbyterians; and now, rescued from the dust and noise and bustle of the packer's warehouse, it silently waits to witness the mysterious future, and again to see "one generation passing away, and another coming."—*Correspondent of the Times.*

LIFE OF ST. ETHELWOLD.

By Hyde Clarke, Esq., F.L.S.

The end of the tenth century is famous in English history for the great extension of the Benedictine order, and of monastic buildings, effected by St. Dunstan, Archbishop of Canterbury, and his two coadjutors, St. Oswald, Archbishop of York, and St. Ethelwold, Bishop of Winchester. These were men of remarkable ability, forming a constellation of talent, which might well affect the monkish writers with admiration, and arrest the attention of the historian. Under their direction King Edgar lavished the wealth of his kingdom on the Benedictines, and he was able to boast of having erected fifty monasteries, many of which flourished in splendour for above 600 years, and became the germs of some of our finest monuments. The reign of Edgar indeed, forms an epoch in our architectural history, and as to St. Ethelwold was committed the direction of the material part of this revolution, it cannot be uninteresting to architects to contemplate the deeds of this ornament of their profession, of whom it is to be regretted that no modern memoir has yet been written.

Ethelwold was born towards the end of the reign of Edward 1st, surnamed the Elder, between the years 910-20, in the imperial city of Winchester, then the metropolis, and was the son of opulent, respectable, and pious parents, his birth, according to the legends, being preceded by omens of his subsequent greatness. St. Swithin and Daniel, Bishops of Winchester, were also natives of the city, as was Ethelwold's after colleague, St. Oswald. Having at an early age shown most pious dispositions, Ethelwold attracted the notice of the illustrious King Athelstan, in whose palace he, with Dunstan, for some time lived, and by whom he was afterwards placed under the care of St. Alfege the Bald, Bishop of Winchester, uncle of St. Dunstan. Having attained the proper age, and having previously received the minor orders, he was consecrated priest by St. Alfege, in the cathedral church at Winchester, at the same time with St. Dunstan, and it is supposed about the year 936 or 937. Besides Dunstan and Ethelwold, there was another priest ordained, who was named Athelstan, and who afterwards relapsed into a bad life, and Bishop Alfege is said on this occasion to have prognosticated the several careers of the young men. Ethelwold soon after retired to Glastonbury, and put himself under the care of his friend Dunstan, who had introduced into that house the rule of St. Benedict. Here Ethelwold afterwards became Dean, and must have been present, and no doubt co-operated, at the period when St. Dunstan was engaged in rebuilding the monastery.

At Glastonbury Ethelwold greatly distinguished himself, not only by his scholastic acquirements, and by the skill with which he taught grammar and prosody, but by his great industry, labouring with his own hands, and even cooking and performing menial offices. Being seized with an ardent desire of acquiring knowledge, the dean had intended to travel on the continent, but was prevented from carrying his design into execution by the Queen-mother Edgiva. This princess was the daughter of Sigeline, a Kentish earl, and mother of King Edmund 1st, and the reigning King Edred, whom she advised not to allow such a man as Ethelwold, whose wisdom and acquirements she highly praised, to leave his kingdom. The king, pleased with hearing such a character of Ethelwold, took great interest in him, and at the persuasion of the Queen-mother, gave him an estate at Abingdon, with the charge to restore an ancient monastery, then greatly dilapidated, consisting of a wretched building, and only possessing 40 manses. This event is generally said to have taken place in 954, but according to Ingulf and the Croyland charters, it was six years before, namely in 948. With the consent of his abbot Dunstan, and no doubt by his influence, Ethelwold went to Abingdon with Osgar, Foldbert, Friwegar of Glastonbury, Ordbert of Winchester, and Edric of London, and soon collected a body of monks, of whom he, by the king's wish, was ordained Abbot, and he then set himself to work, by head and hand, to carry out the task imposed upon him. From the king he obtained large estates at Abingdon, and a grant from the treasury, and he found in the queen-mother a liberal benefactress. From the king Ethelwold obtained a charter of ample privileges, which he himself appears to have illuminated. On a certain day the king came to the monastery, laid the foundations himself, and measured them out, giving directions also how the works should be prosecuted. At the banquet given in honour of this occasion, Ethelwold is represented by his biographers as having begun his career of miracles, by a prodigy much better suited to the taste of those times than of these, having furnished to the numerous Northumbrian guests an inexhaustible supply of wine from one jar. It appears to have been the practice in those days to board the workmen, and one of the legends relates that the monk who had the charge of supplying the workmen with provisions was named Alfstan, and that he performed his duties most laboriously and assiduously, not only cooking and serving out the provisions, but himself lighting the fire, drawing water, and cleaning the dishes. Abbot Ethelwold, seeing him one day engaged in performing his accustomed duties, begged him to dip his naked hand in the cauldon, and to reach a piece of meat, which Alfstan did without scalding his hand, a proof of the religious purity of himself and the abbot, and of their unrefined manners. Among Ethelwold's gifts to Abingdon, most of them the work of his own hand, were a gold sacramental cup of great weight, three crosses of pure silver and gold, lost in the troubles of Stephen's reign, and candlesticks, censors and other vessels for the service of the church of pure silver, and some adorned with precious stones. Many of these were afterwards carried off by a Norman monk of Jumieges. At the request of King Edgar, Abbot Ethelwold also made a silver altar table of the weight of three hundred pounds, and which long remained admirable for the delicacy of its workmanship. He also made two bells with his own hands, and put them in the belfry with two larger ones, which had been made by St. Dunstan. Another of Ethelwold's works was a kind of chime consisting of a wheel full of bells, called the golden wheel, on account of its being gilt, and which was used on high festivals. Abbot Ethelwold was famous for preserving the sanctity of manners of his flock, but he seems to have been by no means illiberal as to matters of eating and drinking, his allowances to the monks being so bountiful as to become matters of proverb. As a ruler of the monastery Ethelwold acquired the highest reputation, and formed a school for singing and reading the service, to which persons from all parts of England resorted. Being greatly desirous of securing uniformity in the mode of performing the service he sent to Corby in France, then famous in this respect, and obtained some skilful monks as instructors. He also sent one of his monks, named Osgar, to the Benedictine Abbey of Fleury to study the rules of the order in that school. This Osgar, there is reason to believe is the one who succeeded our Abbot at Abingdon. Ethelwold exerted himself to a great degree for the advancement of his house, for which he obtained more than six hundred cassates of land, and charters from Edred and Edgar. One of his chief works at Abingdon was a cut which he made from the river Isis to supply the abbey with water, and also to work a mill, which he built. While digging for this canal the excavators found in the sand near the monastery of St. Helen, an iron cross, which Cessa, Viceroy of Wessex, and founder of the old abbey, had caused to be laid in the tomb on his breast. This cross was translated to the abbey, and became famous under the name of the Black Rood or Cross, upon which no one could take a false oath under pain of death, for it was believed to be partly made out of one of the nails of the cross, and sent by Constantine the Great or some of his British followers to England. It is further related that the monks having sometimes attempted to adorn this cross with gold or silver, as fast as they put it on one day it fell off and dissolved on the next. Abbot Ethelwold's zeal for his monastery was great, working even with his own hands, and having as his biographer states, attracted the especial despite of the devil, had on one occasion a heavy beam thrown at him by the great enemy, which knocked him into a pit and broke several of his ribs, and if it had not been for the pit the Abbot would have been crushed to pieces. As it was he soon recovered. Under his government the house prospered in sanctity, and a young boy, who was a favourite of the monks, had on his death-bed a beatific vision of the glories of heaven.

The time was now arrived when the talents of Ethelwold were to shine in a still more extensive sphere, the unfortunate King Edwin, pursued by the monks, had lost the greater part of his dominions, which had rebelled to his brother Edgar, and in 959 this patron of the monastic order obtained by the death of his brother the undivided rule of the whole empire. In 958 Edgar had granted a charter to Abingdon, and in 960 at Dunstan's request he chose our Abbot to undertake the work of the restoration of Evesham, who went there, restored the monks and appointed Oswald Abbot. Of Ethelwold's subsequent government at Abingdon, we have nothing more to relate than that having made that abbey one of the great schools of learning and piety, it became the nursery, whence the new monasteries of King

Edgar were supplied with pastors. A prayer for the prosperity of Abingdon remains as a monument of Ethelwold's love for that institution, and as a testimonial of his scholarship.

In 963 Brithelm, Bishop of Winchester, having died, Ethelwold was appointed to succeed him, and thus became bishop of his native city, which as before said was then the metropolis of the country. On St. Andrew's eve in this year which fell on a Sunday, Ethelwold was consecrated by Archbishop Dunstan, and immediately entered on his labours, finding his cathedral greatly needing repair, and what affected him more his canons of irregular life. In 964 we find Bishop Ethelwold's signature to three charters of Worcester Abbey, and it was in the same year that he was engaged in the restoration of Chertsey monastery in Surrey, sending to Abingdon for thirteen monks of whom Ordbert, a fellow townsman of the Bishop's, and originally of Glastonbury monastery, was appointed Abbot. In 965 we find the Bishop busy with the reform of the two monasteries at Winchester, in which he had great difficulties to contend with. Only three of the canons, Edsy, Wulsy and Wilstan could be induced to put on the cowl, the others retired, and were replaced with monks from Abingdon. Some of the displaced canons attempted to revenge their disgrace by giving the bishop a poisoned cup, but he soon recovered from the consequences. The result of these discussions was the holding of the two celebrated councils of Winchester and of Calne, at the first of which the cause was given against the seculars by a miraculous voice from a crucifix, and at the latter, on Dunstan appealing to God, the floor sank down and the adversaries of the monks were precipitated among the ruins, Dunstan and his friends remaining safe. In the preparation for this second miracle it is more than probable that Bishop Ethelwold was concerned.

Ethelwold was now high in power, holding one of the chief episcopal dignities, a minister, confident and confessor of the king, he took a great part in public events. Ethelwold is described with some prejudice by Sharon Turner as a man bred up by Dunstan himself, and of a temper to execute all his schemes. Dunstan was about the same age as Ethelwold, if anything rather younger, and although associates in their youth, and at Glastonbury, it could not with justice be said either by Florence of Worcester, or Adelard, that Ethelwold was brought up by Dunstan. Oswald, was like St. Dunstan, of high connexions, a native of Winchester, and partly educated there, and these two with Ethelwold formed a cabinet, which however obnoxious it might be for some of its schemes, yet it is not to be denied that it greatly promoted the prosperity of the country. Edgar and his ministry greatly patronized foreigners and trade, delivered the country from the scourge of wolves, reformed the coin, improved the navy, and the administration of justice. To return to the immediate exertions of Ethelwold, we learn that he rebuilt and re-established the Abbey of Benedictine Nuns at Winchester, and placed over it, Etheldritha, who had been his nurse. He also rebuilt the other two Benedictine monasteries. In 966 the site of the monastery of Medhamstead was bought by Ethelwold, and a magnificent abbey built, which was named by him Peterborough. According to Hugh Whyte, the Bishop was warned of God in the night that he should go to the Midland English or Mercians and repair the monastery of St. Peter, and that taking his journey into those parts he came to Oundle, supposing that to be the place, but was warned a second time, that he should follow the course of the river, he came to Medhamstead, and here the Lord appeared to him a third time and directed him by a singular omen, how he should proceed. Having cleared the site of the church, which he found used as a receptacle for herds of cattle, he returned to Winchester to make preparations for the restoration of the monastery. When having put up fervent prayers to God to incline the hearts of King Edgar and his queen and his court, to contribute their assistance to this work, he was overheard by the queen, who thenceforth solicited the king for its reparation, and he accordingly patronized the undertaking. Ethelwold among other measures purchased the fourth part of Whittleseamere, and many other endowments. In this same year he signed a charter for Croyland Abbey, and for the abbey of Hyde, at Winchester, and at London in the end of the same year, he united with the archbishops and bishops in a deed threatening the censures of the church on any disturbers of Croyland.

In 968 the Bishop attached his signature to two charters of Wilton Abbey, and it was most probably about this time that he received at that convent the vows of St. Wiltrude or Wulftrude, the mother of St. Edith. In 969, the distinguished scholar Alfric who was a pupil of Ethelwold's, was appointed Abbot of St Alban's. In 970 the Bishop translated the relics of St. Swithin from the churchyard of Winchester to the cathedral. In this same year although much occupied with his disputes with the monks at Winchester, Ethelwold was appointed by the king to restore the convent of Ely, and having obtained the Isle of Ely free of regal jurisdiction, he dismissed the priests, gave orders for repairing the church, and established therein a convent of monks. Brithnoth, who had been prior of Winchester, was appointed Abbot, and was succeeded at Winchester by Leo the provost. Brithnoth who was consecrated by Dunstan and Ethelwold, was afterwards unfortunately assassinated by order of the Queen Dowager Elfrida for refusing to comply with her passions. For Ely the Bishop obtained many grants of land, and he was a subscribing witness to two of its charters. In this year Ethelwold succeeded in completing Peterborough, and King Edgar being desirous to see it went thither, with the Archbishops Dunstan and Oswald, and attended by most of the nobility and clergy of England, who all approved and applauded both the place and the work. It was Ethelwold's happiness also to discover some very ancient charters bestowing great privileges on the place. It is to be remarked that at this time the prelate was constantly engaged travelling about, superintending the works, and examining the convents. During one of these journies it is related that performing mass in a country parish, the priest whose duty it was to take care of the sacred oil, having left the vessel behind him on the road, went back to find it, and to his surprise not only found it safe, but marvellously replenished.

In 971 the Bishop attached his signature to two charters for Ely, and the next year he prevailed upon Edulf, chancellor of King Edgar, instead of going to Rome, to labour in the restoration of St. Peter's church at Peterborough. Edulf approving of this advice, accompanied the king to Burgh, offered all his wealth to the monastery, assumed the monk's habit, and became first abbot of Peterborough, which he afterwards left for the archiepiscopal seal of York. In 973 Ethelwold subscribed the charters of Ramsey and Thorney. In the succeeding year the Bishop was at Wilton, signed one of the charters, and received the vows of St. Edith, natural daughter of King Edgar and St. Wulftrude. The Bishop used to visit Wilton from time to time, and on one occasion reproved St. Edith for wearing splendid garments, not being aware that she had haircloth next the skin. Edith replied that the Almighty looked not to the garment, but to the soul, and that he would as well receive her with splendid robes as in the attire of poverty. The Bishop in this year (974) translated the relics of St. Withburga and other saints into the new church at Ely. This same year Ethelwold was applied to to use his influence with the king respecting the foundation of St. Neot's in Huntingdonshire, which was begun by Earl Alric and his countess Ethelfleda. Ethelwold also consecrated the church and took it under his protection, sending monks from Ely and Thorney.

In 975 a charter was obtained for Winchester by the Bishop and subscribed by him, and shortly afterwards King Edgar died. During the reign of this prince Ethelwold also signed charters for Westminster, Rochester, Ramsey and York. Dunstan and Ethelwold immediately crowned Edward the Second, surnamed the Martyr, as King, but they soon found in the Queen Dowager Elfrida a powerful antagonist, bent upon their ruin. One of the results of these discussions was as before mentioned, the holding of the councils of Winchester and Calne, and the country was distracted both with civil and religious broils.—In 978 Elfrida proceeding to greater extremities, murdered the king, who was succeeded by Ethelred, surnamed the Unready. This prince was crowned on the Sunday fortnight after Easter, in 979, at Kingston, by Dunstan, Oswald, Ethelwold, and nine other prelates.

In 980 Ethelwold completed one of his great works, the cathedral of Winchester, which he rebuilt from the ground, obliging the monks themselves to assist with their own hands in the work. It is related that one of them named Guth, being at the top of a high scaffold at work fell down, but by the protecting influence of our saint, received no injury, climbing up again and resuming his labours, as if nothing had happened. In this year Ethelwold added to the cathedral the crypts or vaults under the east end of the church, and the walls, pillars, and groining of which remain in much the same state in which he left them, and are executed in a firm and bold, though simple and unadorned manner that gives no contemptible idea of Saxon art. A weather cock and organ are enumerated among his performances, and he enriched the church with the shrines of St. Swithin, Birin, Brinstan, St. Alfege and St. Edburg, when a farther rededication took place with great splendour, in the presence of King Ethelred, Archbishop Dunstan, and eight bishops. In 981 the Bishop of Winchester signed the charter for Tavistock, and ordained Elsy as Abbot of Ely.

It was in this year that the Danes attacked and plundered Southampton, and put Winchester itself in peril, and in the next year our prelate buried Alderman Ethelmer. In 983 Ethelwold visited Dunstan at Canterbury, and that saint foretold to him his approaching death. In 984 we find his last public act in his attestation to the charter of Shaftesbury, and in that year being taken ill at Beddington, in the county of Surrey, he died there on the 1st of August 984, his death being it is said accompanied with miraculous circumstances, his body having all the freshness of life, and his face the rosy hue of that of a young boy. His body was transported with great pomp to Winches

ter, and he was buried in the cathedral, but in what part is uncertain.

As an ecclesiastic Ethelwold has received the unbounded admiration of the monkish writers, but from every one his conduct during the famine at Winchester, leaving all other things out of consideration, entitles him to universal praise. During that severe famine he caused all the church plate to be sold in order to purchase provisions for the poor, remarking that the church, if reduced to poverty, might be again enriched, but that if the poor were starved, it was not in the power of man to recall them to life. His life is said to have been of a most hermit-like character, devoting himself to labour and study. Of his miracles besides those already alluded to, many are mentioned, particularly of the arms of a thievish monk being suddenly bound down to his side, of the Bishop's being found by the monk Theodoric overcome with fatigue, and sleeping over his book, how the monk sat down in the bishop's seat, was frightened by a horrible vision, and temporarily blinded for his temerity, how another monk Leofred, under similar circumstances, found that the candle had fallen on the book without even greasing it.

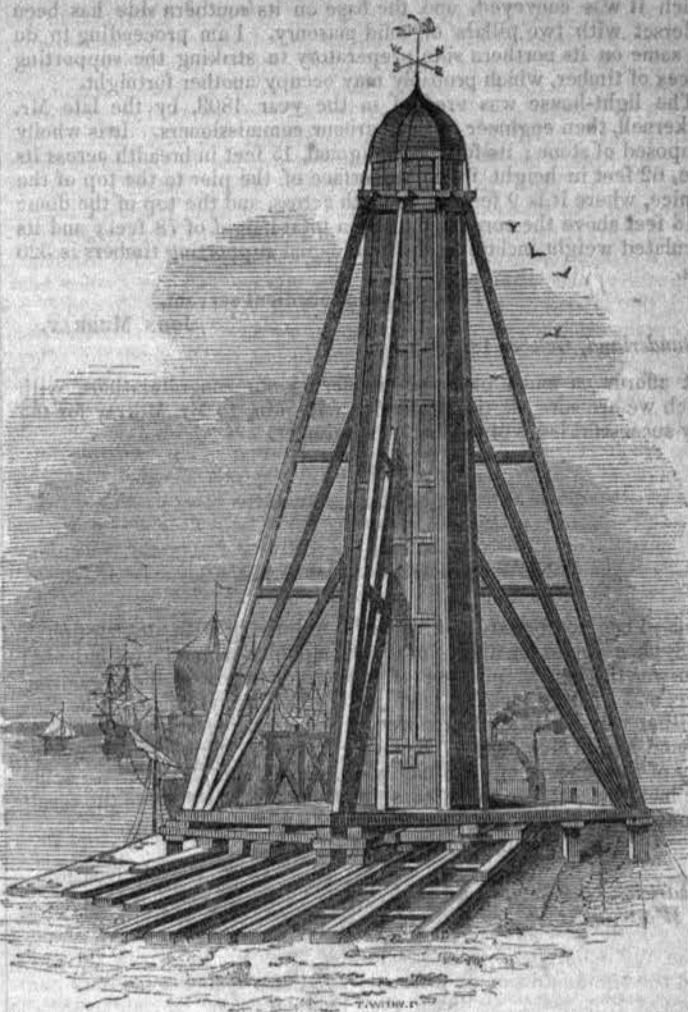
Ethelwold is represented as active in person, of acute genius, and of extremely retentive memory. We know that he patronized and practised every liberal art, and we have Alfric's testimony that he was one of the great restorers of learning in that age. Of his writings we have no specimen, except the prayer for the prosperity of Abingdon, but of his scholarship we can entertain no doubt, his zeal for the advancement of learning causing him throughout his life to teach personally, and he was consequently the instructor of many of the most distinguished characters of the age, both in civil and religious life. As an illuminator he is said to have had great skill, and his love for music showed itself in the foundation of the school at Abingdon. As an architect he is said, like his successor William of Wykeham, to have been a great builder both of churches and divers works, both while abbot and bishop, and we may note his mechanical skill in the donations he made to Abingdon. Besides the canal at Abingdon, he was also the designer of a similar work at Winchester, the benefit of which, says the historian of Winchester, is still felt by the inhabitants. They experiencing great inconveniences from the want of water, which then only flowed in one current at the eastern end of the city, St. Ethelwold made different canals, one of which begins near the village of Worthy, and thus distributed the water, at great toil and expense throughout the greater part of the city. He is also said to have been the builder of what is call St. Swithin's chapel at Winchester.

For a character so distinguished in all time the greatest admiration has been felt, and we have his life from the pens of two cotemporaries and pupils, Alfric, monk of Abingdon, and Wolstan, chanter of Winchester. It was in 996 that Alfhelm of Wallingford, being attacked with blindness, was directed by a vision to the tomb of Ethelwold and to Wolstan, who also had a vision of the saint, and on Christmas eve of that year, the body of the saint was enshrined. The offices in his honour are to be found in the Acta Sanctorum for the 1st of August, with two hymns in his honour, one of which is a curious specimen of the alliterative form adopted in Latin. The episcopal chair of this eminent man long remained an object of veneration and popular awe, it being believed that those, who, while they sat in it, instead of attending to the divine office, gave way to sloth and drowsiness, were punished with terrific sights and painful visions. A representation of St. Ethelwold is said to exist in the west window at Winchester.

[Authors consulted:—Wolstan's Life of St. Ethelwold; Acta Sanctorum; Acta Sanctorum, Ord. St. Benedict; Mabillon, Annales Ord. Sancti Benedicti; Butler's Lives of the Saints; Dugdale's Monasticon; Milner's Winchester; Britton's Winchester Cathedral; Warner's Hampshire; Lyson's Berkshire; Turner's Anglo Saxons; The Saxon Chronicle; Knight's Pictorial History of England; Penny Magazine, No. 503; Rudborne's History of Winchester in Wharton's Anglia Sacra; Life of St. Dunstan; Life of St. Oswald; Life of St. Edith; Life of St. Alfege the Elder.]

Ramsgate.—We understand that a survey is in progress for the purpose of ascertaining the practicability of a plan for forming a harbour of refuge capable of containing a fleet of men-of-war, or merchantmen of the largest class. It is well known that the Goodwin and Brake Sands afford considerable shelter to this part of the coast, and if the additional works necessary for forming this bay into a harbour of refuge can be made at a comparatively moderate expense, it will be one of the grandest and most valuable undertakings of these modern and wonder-working times. The survey is being made under the direction of Sir John Rennie, by Mr. Hamilton H. Fulton.—*Kent Herald.*

SUNDERLAND LIGHT HOUSE.



In the Journal for September last, we gave a short account of an unusual occurrence, the removal of a Light-house, which we are happy now to announce has been firmly set upon its new foundation. The above engraving is a view of the light-house taken during its progress by Mr. Nicholson, of Newcastle. The removal from the North Pier was commenced on the 2nd August, and transplanted to the eastern extremity of the pier, a distance of 500 feet, and placed upon its new foundation on the 30th September last, and all the work will be completely finished by the 2nd instant, the whole period occupied being only two months.

The following is the plan submitted by Mr. Murray to the commissioners of the River Wear in May last, when it was under their consideration to pull down and re-erect the light-house on its new site:—"The masonry was to be cut through near its foundation, and whole timbers were to be inserted, one after another, through the building, and extending seven feet beyond it. Above and at right angles to them another tier of timber was to be inserted in like manner, so as to make the cradle or base a square of 20 feet; and this cradle was to be supported upon bearers, with about 250 wheels of six inches diameter, and was to traverse on six lines of railway to be laid on the new pier for that purpose. The shaft of the light-house was to be tied together with bands, and its eight sides supported with timber braces from the cradle upwards to the cornice. The cradle was to be drawn and pushed forward by powerful screws along the railway above mentioned, on the principle of Morton's patent slip for the repairing of vessels." The project was approved of, and the necessary arrangements made for carrying it into effect; the only deviation from its plan being, that during the progress of the work a windlass and ropes, worked by 30 men, were substituted for the screws. Not a crack nor appearance of settlement is to be found in the building.

We have been favoured with the following communication from Mr. Murray, by which it will be seen that the under-setting of the foundations are perfected.

SIR—In reply to your communication respecting the removal of the light-house on the north side of the harbour, I have to state that since it has been brought to its new site I have drawn out the timbers upon which it was conveyed, and the base on its southern side has been underset with two pillars of solid masonry. I am proceeding to do the same on its northern side preparatory to striking the supporting braces of timber, which probably may occupy another fortnight.

The light-house was erected in the year 1803, by the late Mr. Pickernell, then engineer to the harbour commissioners. It is wholly composed of stone; its form is octagonal, 15 feet in breadth across its base, 62 feet in height from the surface of the pier to the top of the cornice, where it is 9 feet in breadth across, and the top of the dome is 16 feet above the cornice, making a total height of 78 feet; and its calculated weight including the cradle and supporting timbers is 320 tons.

I am, Sir, your obedient servant,
JOHN MURRAY.

Sunderland, October 18, 1841.

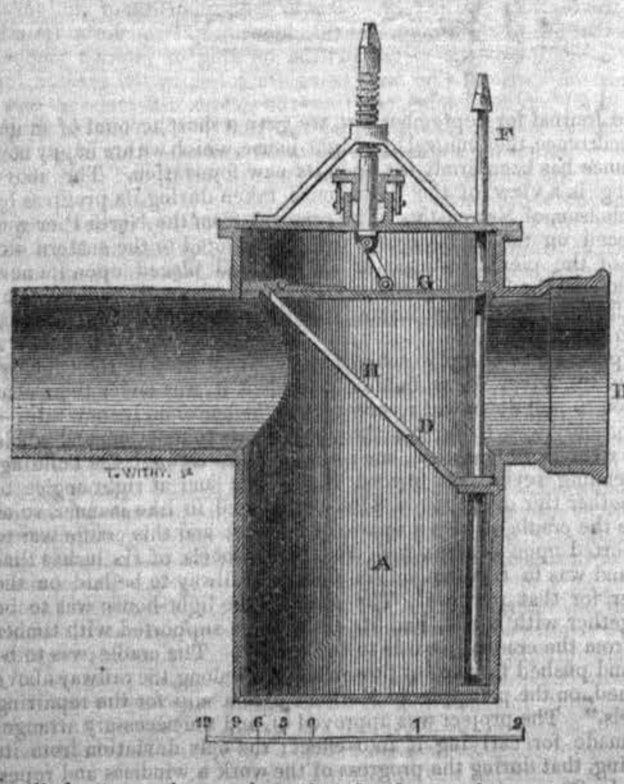
It affords us much pleasure in offering our congratulations, with which we are sure all the profession will join, to Mr. Murray for the very successful issue of the bold experiment.

NEW SYPHON GAS VALVES.

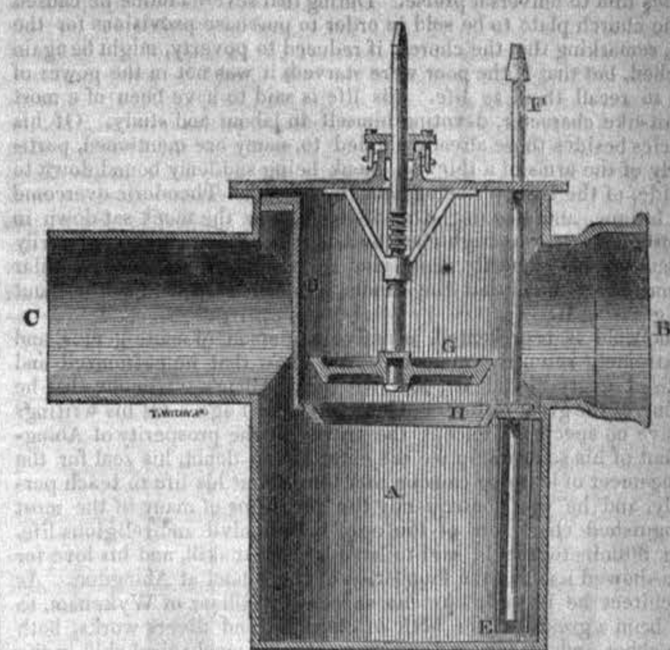
SIR—I beg to forward you herewith a drawing with description of two Syphon-valves for the use of Gas Companies, which I have intended to answer the double purpose of syphon (or receiver) and regulating valve, and I flatter myself I have succeeded in my object. The cost of either valve and syphon united, will be considerably less than the common slide valve alone. Knowing it to be a subject of interest to many of the readers of your highly esteemed Journal, I have for some time had this subject under consideration, and I now place the result in your hands, by an early insertion of which you will oblige.

Sir, your very obedient servant,
THOS. HENRY NIMMO.

Chartered Gas Company,
Westminster Station,



A, cylinder to receive condensation, &c. from mains.
B, the inlet to be jointed into spigot of pipe.
C, the outlet to be jointed into socket of pipe.
D, division plate directing the inlet from the outlet, and bolted to the cylinder.
E, the tube to convey condensation, &c. from main into cylinder.
F, is a smaller tube placed within E, through which this condensation is drawn off.
G, the valve.
H, the valve-seat.



NOTE.—The supply of gas will be regulated in the same manner as other valves.

October 15, 1841.

IMPROVED RAIL AND CHAIR FOR RAILWAYS.

SIR—Having been practically engaged in the construction of railways for some years, my attention, about three years since, was directed to the designing a rail that should overcome several of the disadvantages, if not failures of the then, as well as the one still used, of intermediately supported rails.

My observations were then, and are now, with regard to that description of rails at present used. *First*, that the greatest strength of the rails is not in the direction of the force which they are intended to bear.

Secondly, that there is invariably considerable attrition between the rail and chair, and between the joints of the rails, and from which a portion of the useless noise so much complained of on Railways arises.

Thirdly, the fixing of the rails is subject to failure, by the loosening of the key or wedge that is used to fix them in the chair from the attrition consequent upon the imperfect connection between two hard surfaces, or from the wooden wedge having greater force to sustain than it is able without being compressed.

Fourthly, from the great force required to roll the irregular forms of the present rails, the same are very frequently flawed or fractured by the force applied to change the metal to the form so widely different from the bar converted, or otherwise in cooling from the sudden difference in bulk of metal after the rails are rolled.

From the preceding observations I designed, and have practically proved the following rail, which I shall feel grateful for the indulgence of making it public through the medium of your valuable and widely-circulated Journal. I respectfully submit it to the consideration of the profession, that it claims the following advantages.—First, the equal strength to resist or bear the weight or force of the transit of carriages with one-tenth less metal than intermediately supported rails now in use.

Secondly, requiring less power to roll the metal, and there being much less possibility of the rails being fractured by the process of rolling.

Thirdly, the greater security in fixing the rails in the supports, particularly at the joints.

Fourthly, the simplicity and strength of the supports added to the

security of the rail, lessening the attrition, and being constructed with as little or less metal than the supports generally used. It will be admitted according to theory and practice, by a perfect cylinder rolling on a perfectly horizontal plane, the weight of the cylinder is received in vertical pressure on the surface of the plane. But as the wheels used on railways are not portions of cylinders but are portions or frustra of two cones with their bases opposite, formed by an axle (whose centre is the axis of the cones) at the distance of the gauge of the rails; although the surface of the rails should be perfect planes, the pressure or weight and force of the vehicles, and their contents transmitted from the surface of the wheels on to the rails, will not be vertical but at right angles to the head or surface of the wheels (which are portions of two cones), consequently the resistance to the force from the wheels ought to be in the direction the force is received from the surface of the wheels, and the strength and support for the wheels of railway carriages ought to be laterally as well as vertically. In the common intermediately supported rail, this is endeavoured to be obtained laterally by the flange of the rail, and vertically by the depth of the rail, assisted a little by placing the chairs declining a little inwards, but which is entirely at the mercy of the workmen employed to lay the rails.

Fig. 1.

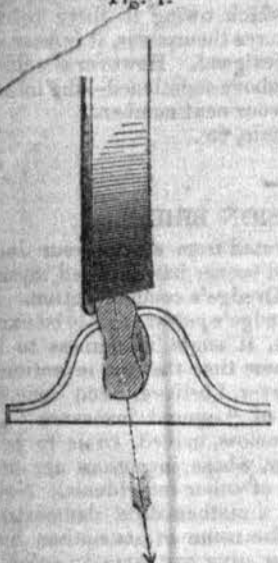


Fig. 2.

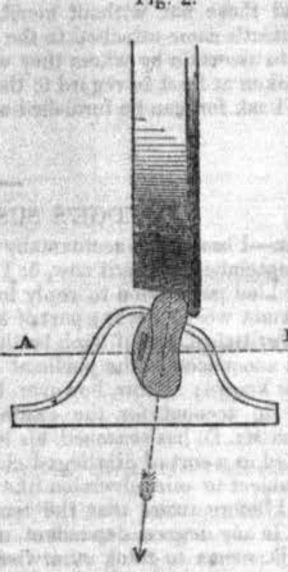


Fig. 3.

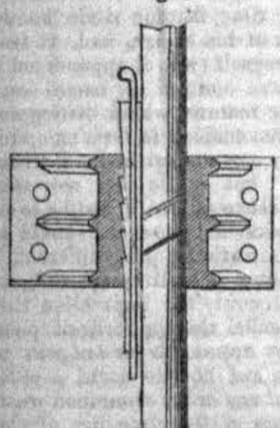
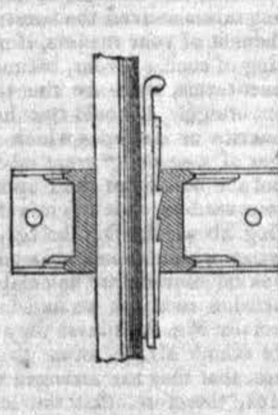


Fig. 4.



From the preceding axioms, I will endeavour to show, that my design is practically on the right principle for intermediately supported rails, in as clear and concise a manner as I possibly can, by reference to the diagrams.

Figs. 1, and 2, are elevations of two chairs, with portions of wheels thereon, and section of rails. Figs. 3, and 4, are two chairs cut off at the line A B in fig. 1, shewing the juncture of two rails in the wide chair, fig. 3. Fig, 5, is a perspective elevation of the rail, shewing the tongue joint. Figs. 6, and 7, are diagrams of two barrels, the railway wheels are supposed to be portions thereof. The one fig. 6, supported by two half-inch boards four inches wide, placed at right angles to the bearing surface of the barrels. The other, fig. 7, supported by one-tenth more wood in the shape and position of the common rail; this is suggested as a cheap and easy practical experiment to test the principle of the rail.

Fig. 5.

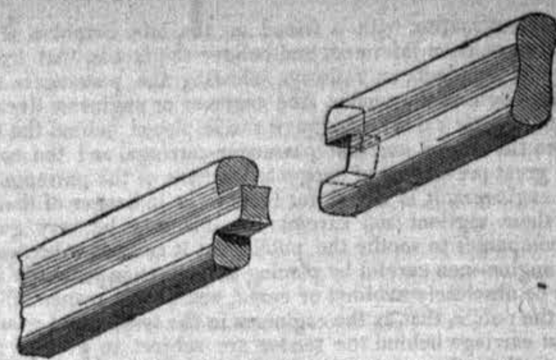


Fig. 6.

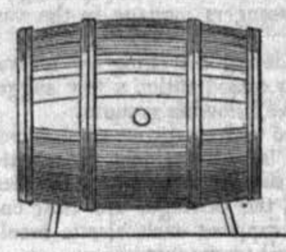
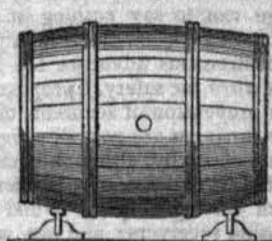


Fig. 7.



With regard to the rail being equal in strength with one-tenth less metal, arises from its being placed so as to receive the direction of the force or weight from the surface of the wheels in the direction of the greatest strength of the rail, and from its impracticability to bend outwards without rising upwards, so long as the weight or force is not more than the rail will bear without flexure, and the tendency of the wheels to thrust outwards, will of course prevent its bending inwards. In the rolling metal in the several forms they are now used on railways, the force or power required is in the proportion of the several angles that are to be formed, and the departure of the form from the previous section of the metal, and the forming of internal angles, is not only the cause of the rails being fractured by the greater force required for internal angles, but from the sudden difference in bulk of metal on its cooling, consequently a rail that has no internal angles, and the form, but the slightest departure from the section of the metal converted will require less power or force to roll it, and there will be less liability to fracture.

The security of fixing the rail in the chair consists in avoiding the attrition of two hard surfaces of equal density, by introducing a piece of metal more malleable than the rail or chair between them, and by securing the rail with a wood wedge, prevented from coming out by means of an iron key being driven into the centre of it, causing the wood to fill the ratchets in the chair as shown in figs. 3 & 4, and the wood having the greatest pressure downwards on the rails, as shewn in figs. 1 and 2, keeps the rail securely from rising, and the wood receives but little or no pressure from any weight transmitted from the surface of the wheels as shewn in figs. 1 and 2, and is therefore not liable to failure. The security at the juncture of two rails consists in their being kept firmly down in the chairs by the manner of their jointure by a tongue joint, as shown in fig. 5, are prevented from rising one above the other, and the noise is prevented by introducing a piece of thin cast lead between the meeting of the two rails, and by the chair being made of greater width as shewn in fig. 3. The chairs are without any internal angles, and consequently are not weakened, nor do they require additional metal to counterpoise against it, and their being no outward pressure by the rail, the chair does not require to be cast so heavy as those used to resist the outward pressure of the vertical rail. In conclusion, on this design I have only to add, I have full sized models of the above rail and chairs, and should it meet with the approval of the profession, I shall be happy to undertake the laying of the permanent way on any line of railway.

And am, Sir,
With much respect,
Your obedient servant,
W. B.

PROPOSED IMPROVEMENTS IN RAILWAY CARRIAGES FOR THE PREVENTION OF ACCIDENTS

Sir—In conversation with a friend on the late Brighton Railway accident, I have been informed, and believe the fact is, that from the generality of accidents on railways affecting the passengers on the first carriage behind the tender, (the engineer or engineers lives being considered of little value) a luggage van is placed behind the tender, or between the tender and first passenger-carriage, and the company do it as a great preventive of danger to the lives of the passengers, and as to the engineers, it is better for them to be in danger of their lives to make them vigilent and careful; all this may be very good for railway companies to soothe the public, but it can never be necessary to make engine-men careful by placing their lives in jeopardy beyond what can be absolutely avoided or eased, and I most respectfully submit it to the public, that as the engineers in the tender, and passengers in the first carriage behind the tender are subject to greater risk of their lives than the passengers in the second carriage behind the tender, and those at greater risk than the passengers in the third carriage and so on, the risk decreasing in the ratio to the distance of the carriage from the engine, the cause ought to be solved, or at least an attempt made to render the tender safer, and the first carriage as safe as the fifth one is now, and not let it rest by placing even a luggage van, to say nothing of passengers luggage in the van, in a situation of such imminent risk.

As a strenuous advocate for rendering travelling by railway the *ne plus ultra* for safety, I propose for consideration a few suggestions for the prevention of accidents on the following grounds.

The carriages are now all provided with elastic concussion receivers of equal elasticity, although it must be quite evident the elasticity is not acted on equally. To illustrate this we will suppose the elasticity of each carriage equals 1, and all the carriages are close on their concussion receivers; and we will suppose each elastic receiver to have already given way a length equal to one foot.

A train of carriages are started down an inclined plane, and at their arriving at their maximum velocity, an obstruction is met with, and the engine is stopped; the result will be that the tender comes with a force that the elasticity of 1 in 1 foot is completely overcome, and a concussion is the result between the tender and the engine to such an extent as to throw the men off or out of the tender, and the tender being stopped, the first carriage adjoining thereto receives a concussion on it, although the elasticity between the tender and engine had allowed the same to be eased one foot, and consequently with the elasticity between the first carriage and the tender of 1 in one foot, the first carriage is eased by the elasticity of one in two feet, but this proves to be insufficient and so does the elasticity or the easing received by the second carriage which is equal to 1 in 3 feet, but the elasticity received by the third carriage, proves in some cases sufficient to overcome to a very great extent, the concussion caused by the obstruction met with. As an improvement, I propose that the elasticity between the engine and tender should be increased to the greatest extent possible, say five feet, and the receivers of the concussions be kept close to each other, that is the drawboys or connecting chains should be just long enough to keep the receivers close, this would give the luggage van behind the tender, the safety the sixth carriage, and the first passenger-carriage the safety, the seventh one now enjoys. Trusting my motive in forwarding the preceding remarks, being for the safety of railway travelling, will be a sufficient plea for requesting it a place in your columns.

I am, Sir,
Your very obedient servant.
W. B.

ANONYMOUS ARCHITECTS.

Sir—I should feel obliged to any of your correspondents who would supply some information relative to the Market Cross at Shepton Mallet, which I understand is a new structure, and a handsome one of its kind. I could further wish to ascertain who was the architect of the building occupied by the "Society of Arts," at Birmingham, his name not being mentioned in Drake's "Picture" of that town, although the structure itself is there spoken of as "one of the most striking edifices" in the whole place. Surely local "Guides" might afford some information as to the authorship of modern buildings—which could be ascertained on the spot without any very great difficulty; or are we to suppose that the public have not the slightest curiosity whatever as to such trivial matters, and care no more who was the architect that designed, than who were the masons and labourers employed upon a public edifice.

In the case of a paltry building, the concealment of the architect's name may be an act of great kindness towards him; but it is somewhat preposterous to speak of one as "a splendid edifice"—"a truly elegant piece of architecture;" or in other terms of very high praise, and yet treat the author of the design as if he were a mere nobody, whose name was not worth recording at all,—not so much as that of an organ builder, for artists of the last description come in far more frequently for some share of notice.

Such being the case, it becomes a question whether its architect's name ought not invariably to be inscribed on every building making any pretensions to design;—I do not mean that it should be conspicuously placed so as to attract notice, but inscribed quite unobtrusively somewhere on the level of the eye, where if sought it could at once be found out,—in fact just as the name of an artist is attached at the bottom of an engraving; and if no objection be made to this last practice as savouring of presumption or conceit, hardly could there be any scruple as to adopting a similar practice in regard to buildings. In some few instances it might be altogether superfluous,—for example in the New Houses of Parliament, and the Royal Exchange, it being already matter of notoriety throughout the kingdom, that Barry is the architect of the one, and Tite of the other. But there are many works —and those not without merit, of which owing to there being no architect's name attached to the structures themselves, it is very difficult to ascertain by whom they were designed. However should I be mistaken at least in regard to the two above-mentioned—the information I ask for, can be furnished me in your next number.

I remain, &c.
Z.

DREDGE'S SUSPENSION BRIDGE.

Sir—I have been accidentally prevented from seeing your Journal of September last until now, or I should sooner have availed myself of your kind permission to reply to Mr. Dredge's communication. I do not know whether it is a part of Mr. Dredge's *patent right* to be exempt from criticism, but if such be the case, it ought in fairness to have been announced to the public at the same time that the invention was made known; as this, however, has never, I believe, been done, it is hard to account for the expression of "injured innocence" with which Mr. D. has seasoned his letter, unless, indeed, he is to be regarded as a sort of privileged character, whose inventions are not to be subject to animadversion like those of other individuals. Neither was I before aware that the truth of a mathematical demonstration was, in any degree dependent upon the name of its author, but as Mr. D. seems to think otherwise, I now give my name, in order that he may no longer suffer from the intellectual trammels which it would seem I have most unwittingly imposed upon him. It is much to be wished that Mr. Dredge, at the same time that he made known my having misconceived the construction of his bridge, had, at least for the benefit of your readers, if not of myself (who it appears am undeserving of such a favour, because I have omitted my name) stated in distinct terms, what are the peculiar features which distinguish his patent bridge. I should thus have been enabled to form an opinion of the merits or demerits which it may possess, without incurring the danger of a second "great mistake;" but as the case now stands, I do not see how I can enter upon the discussion with justice to myself or your readers, as it might very possibly happen that I should not be writing about Mr. D.'s bridge, but something quite different. The drawings which appeared in your Journal (Vol. III. page 193), it must I think be allowed, are calculated to convey the impression that the suspension rods are arranged in parallel though inclined positions, especially Fig. 3, at least they do not appear to be *tangents* to the curve which Mr. D. *seems* to assert, and no one could suppose, of course, that they are arranged without any order or method whatever. I think, therefore, that the inspection of the drawings alluded to, would necessarily lead to the conclusion that the rods were parallel. If, however, I have fallen into an error upon this point, which, however, Mr. D. does not distinctly assert, it will follow that such of my remarks as are founded on the supposition of the rods being parallel, will immediately fall to the ground as inapplicable to Mr. D.'s bridge, and I am quite willing to allow him the full benefit of this, claiming, however, at the same time for myself, the privilege of examining his bridge *de novo*, when I know what it is; and he may rest assured that should I discover any merits which were not before apparent, I shall at once freely acknowledge them.

I remain, Sir,
October 11. Your obedient servant,
George F. Fordham.

ON THE FORMS AND PROPORTIONS OF STEAM-VESSELS.

SIR—A former paper on this subject, which you were so good as to give a place in your columns, having occasioned the observations of your correspondent A. M., before proceeding further, his letter demands my attention. I think his objections to the method adopted for ascertaining the comparative resistance of the simple forms of vessels on which the calculations were founded, arises principally from his having overlooked the effect of what has commonly been called the "minus pressure," that is, the loss of pressure abaft, occasioned by the water's not closing in immediately on the vessels' after body, on account of the rapidity of her motion. This effect of motion is equivalent to an increase of pressure on the bow, and when the velocity is such that the water will not close in on the *lowest* part of the immersed body, the case becomes one of simple hydraulic pressure increased by motion. Besides the loss of pressure occasioned by the absolute absence of water behind the moving body, it has always been found that there is a great reduction in this respect before such a velocity has been attained as would prevent the closing of the water behind. This is occasioned by the *rarefaction* of the water, or its being mixed with a large portion of air, or leaving intervals of unoccupied space in the wake of the vessel, and though these effects are of course diminished, (as it was my intention to notice as I proceeded with the subject) by the proper modification of form in the after body of a vessel, I believe that in the simple forms which I have supposed, moving at such velocities as are acquired by large steamers at the present day, the result of these two sources of resistance would be such, that the sections would rest very nearly on the merits of their respective hydraulic pressures. It is the difficulty of estimating the exact influence of these two effects, which has caused all experiments hitherto made, as far as I can ascertain, to prove defective in their results, and apparently to contradict themselves at different velocities. Sir Isaac Newton assigned twice the pressure given by M. Bomit, and though he shewed his own results to be defective, they long remained the best data on which calculations on this subject could be founded. The experiments of the London Society for the Improvement of Naval Architecture, did not afford the means of establishing any certain law for estimating these resistances, and the velocities at which their trials were made being comparatively low, I do not think I am altogether unauthorised in adopting this mode of calculation for high velocities and simple forms. Some experiments detailed by Dr. Hutton, on the motion of bodies in air tend to support this view, as they show that resistance increases in a larger ratio than the square of the velocity even in an elastic fluid, and the deviation from this ratio becomes greater and greater as the velocities are increased, a result most probably arising by decrease of pressure on the hinder part of the body, caused by the rarefaction of the air as the speed is increased.

After this explanation, I proceed briefly to notice the two points of carriage of fuel, and action of the paddles as compared in vessels of the different proportions supposed. If two such vessels required each 400 tons of coal for her voyage, equal to about 16,000 cubic feet of water, the vessel 200 feet long by 40 beam, would have her draught of water increased 2 feet by this additional load, while the other, 200 feet by 30, would suffer an increase of draught of 2 ft. 8 in. We here see that the narrower vessel has the disadvantage in several respects, she has a greater depth in proportion of her body immersed, and suffers consequently an increase of hydraulic pressure. In consequence of the coal occupying a greater depth, on account of her smaller amount of beam, than in the other vessel, her centre of gravity is more raised in proportion, brought nearer to her axis of rotation, if it was before below it, and raised further above it, if in the first instance it was already so, as I believe most frequently is the case. In either case one great source, though perhaps not the principal one, of her stability or power of resisting a rolling motion is diminished; she is rendered less able to carry sail, which may sometimes prove the only resource for safety and less able to resist the stroke of the sea abeam, the latter being very commonly supposed among nautical men to be the cause of the President's foundering. Again, by leaving a smaller depth of the hull vacant for buoyancy above water, her power to rise over a sea is diminished, and she will consequently be wetter and pitch deeper in proportion to her increased load than the wider vessel. And lastly, (supposing her a vessel of the usual form) by bringing her full lines more in contact with the water, her speed must suffer a most serious diminution. Again, as regards the action of the paddle-wheels, supposing the paddles of these two vessels to be of equal diameter, and the floats having the same dip at their respective draughts of 15 and 20 feet. The narrow vessel again suffers a disadvantage as compared with the other; for her paddles being sunk deeper, the floats enter the water at a smaller angle to the horizon, and leave it at a greater, and thus the effective action is diminished and the backwater increased. This defect being severely felt in narrow vessels, different means have been tried to counteract it. The mean dip of the paddles has been reduced by raising the wheels higher on the hull, but this method has the disadvantage of making the paddles fly light when the fuel is reduced, the weather wheel frequently hardly dipping; the heavy pedestals for the paddle shaft must also be raised with it, and thus the centre of gravity must also rise, and the tendency to roll be increased, and if the hull be built higher out of the water in the same proportion, an unnecessarily large surface is exposed to the sideway action of the water and wind, and the rolling tendency still further augmented;—besides the engines working more rapidly increase the consumption of fuel without a proportionate increase of speed. The various descriptions of feathering paddles seem most applicable to narrow deep vessels, as it is in such when deeply laden that the oblique action of the floats is most felt; but even here I believe the additional power requisite to overcome their friction is generally considered to counterbalance the gain of power; and the floats being all constantly vertical present a much larger surface to the direct action of a head or following sea, and in such case become additional impediments to speed. The reefing paddle seems most likely to answer the end proposed, but may it not be a question whether the increased speed of the engines, when the wheels are reduced in diameter, does not cause some increase in the consumption of fuel? which would certainly be avoided in a great measure by building vessels of such proportions as would render any such contrivances needless. Feeling the great advantage of experimental evidence in support of expressed opinions, it was my intention to have illustrated these remarks by a few simple experiments, bearing solely on the points they refer to, but on consideration, so many difficulties appeared to oppose the probability of obtaining any data sufficiently accurate by such means as I could command, that this design was unavoidably abandoned. It is to be hoped that the experiments now proceeding under the auspices of the British Association, of the further prosecution of which I was not aware when I entered on this topic, will tend to clear away the difficulties which have hitherto attended the application of theory to this interesting subject, and advance naval architecture to a station somewhat more on a parallel with the present state of the other practical sciences.

I am, Sir, your's, &c.

H. P. H.

COUNT DE PAMBOUR IN REPLY TO MR. PARKES.

SIR—In a paper written by me and inserted in your number for September last: *On the Momentum proposed by Mr. Josiah Parkes, as a measure of the mechanical effect of locomotive engines*, the following passage occurs: "The author tells us that he is more accustomed to handle the hammer than the pen." I have since perceived that I had, there, by mistake, attributed to the paper of Mr. Parkes, *on boilers and steam engines*, a sentence which I had read in the very useful work of Mr. Armstrong, *on the boilers of steam engines*, preface, page xi, Weale, 1839. The two works having come to me at the same time, and being precisely on the same subject, I had made the error of ascribing to the one, what in reality belongs to the other. This point is however without the least importance, having no reference to the arguments presented in my paper, and I correct it only for the sake of accuracy.

Since the publication of the paper above alluded to, Mr. Parkes has printed in several periodicals, a letter in which he accuses me of having misrepresented his sentiments, in my refutation of his strictures against me. I had thought, first, that if my paper itself were put under the eyes of the persons who had read Mr. Parkes's letter, it would, by the full references contained in it, show sufficiently that I had not misrepresented the sentiments of Mr. Parkes; and I had, in consequence, only asked of the editors of the periodicals in which Mr. Parkes's letter had been published, to insert that paper as an answer. But this request having been refused by the *Literary Gazette*, and a mutilated part only of the letter which I had sent with the paper, having appeared in the *Mining Journal*, with the omission of what I considered the most important passages, it becomes necessary for me to make a different answer. Therefore, I beg you to insert in your next publication, the following paper, as a reply to Mr. Parkes's allegations.

I remain, Sir,
Your very obedient servant,
G. DE PAMBOUR.

October 18, 1841.

Supplementary paper, *On the Momentum proposed by Mr. Josiah Parkes, as a measure of the Mechanical effect of Locomotive engines.* By the Count de Pambour.

In a former paper, inserted in the Civil Engineer and Architect's Journal, for September last, we have proved that all the strictures presented by Mr. Parkes, in his paper: *On steam boilers and steam engines*, inserted in the *Transactions of the Institution of Civil Engineers*, vol. iii., against some of the experiments of our *Treatise on Locomotive Engines*, are entirely founded upon errors of his own; and, besides, that his *momentum* or intended "standard" of the mechanical effect of locomotive engines, which he proposes to substitute in place of every other research on the same subject, leads him to conclusions and results altogether faulty.

However, as in a letter inserted by Mr. Parkes in several periodicals (*Literary Gazette*, September 18th, *Mining Journal*, same date, *Civil Engineer and Architect's Journal* for October), he complains that in answering his strictures, we have misrepresented his sentiments, we shall now add a few more observations, to show that we have not misrepresented the sentiments of Mr. Parkes; and, besides, that it is not upon sentiments, but upon facts, that we can establish clearly *that the whole of the calculations and tables of Mr. Parkes are erroneous*, and, as every one of his conclusions and strictures are founded upon the numbers obtained in his tables, *that every one of his conclusions and strictures are equally erroneous.*

For that purpose we shall resume, in the same order, all the articles of our former paper, quoting more particularly the facts, or the expressions of Mr. Parkes, upon which is grounded our refutation.

1st. We have said that, to calculate the mean pressure of the steam in the cylinder of each of the engines submitted by us to experiment, Mr. Parkes uses the *average* velocity of the whole trip between Liverpool and Manchester. This fact cannot be denied, and is made quite evident by looking at his table viii. column 10, table xiii. col. 9, table xvi. col. 2, in which the velocities are headed, *mean velocity of the engines per hour*, and are in fact the average velocities of our experiments, given page 175 of the *Treatise on Locomotive Engines*, 1st edition, and page 253, 2nd edition; with the exception only of the cases in which Mr. Parkes has increased the velocities, from a pretended correction of his own, of which we shall speak in a moment.

Now, in recurring to our former paper, same article, it will be seen that such mode of calculating the pressure in the cylinder, from the *average* or *mean* velocity of the whole trip, is altogether faulty; because it gives only the pressure which would have taken place, if the whole trip had been performed at a *uniform* velocity. But the velocity varied considerably in the different portions of the trip, according to the more or less inclination of the part of road traversed by the engine, as may be seen in our detailed table of those experiments (pages 225 to 234, 1st edition, and pages 389 to 394, 2nd edition of the *Treatise on Locomotive Engines*). And in taking account, *as ought to be done*, of the time during which each partial velocity has been continued, we have proved, in our former paper, that the *real* mean pressure in the cylinder, is very different from the pressure given in Mr. Parkes's calculation. We can, therefore, safely conclude that the pressures, and correspondent volumes, of the steam in the cylinder, presented by Mr. Parkes as the results of his computation, are altogether faulty.

2nd. We have shown a first error, which Mr. Parkes introduces, as a fundamental basis, in all his calculations, and which has nothing to do with his *sentiments*. But he does not stop there. We have said that, moreover, he increases almost all the velocities nearly $\frac{1}{6}$; and to be assured of this, it again suffices to compare, in his paper, table viii. col. 10, table xiii. col. 9, table xvi. col. 2, with our own table page 175, 1st edition, and page 253, 2nd edition, of the *Treatise on Locomotive Engines*. It will be found that the velocity of *Vulcan*, in experiment VI. (table viii. of Mr. Parkes), is increased from 22·99 to 26·90 miles per hour, that of *Vesta*, in experiment V, from 27·23 to 31·60 miles per hour, that of *Atlas*, in experiment III, from 15·53 to 18·15 miles per hour, that of *Atlas* in experiment IV, from 20·59 to 24·07 miles per hour, that of *Leeds*, in experiment VIII, from 21·99 to 26·70 miles per hour, that of *Fury*, in experiment IX, from 18·63 to 21·79 miles per hour, and that of *Fury*, in experiment X, from 21·99 to 23·00 miles per hour. So that, out of ten experiments extracted from our work, seven have been made entirely false by this alleged correction to the *observed* velocities; and this is worse than if the whole of them had been falsified in the same manner, as it would, at least, have left the same proportion between the results. Mr. Parkes makes the same addition to the *observed* velocities, and therefore introduces the same error, in calculating the experiments of Mr. E. Woods, with the *Hecla*, since we find (page 112):

"Mean velocity during the trip...... 29·47 miles per hour.
" *Difference for gradients* .... 1·46 „

"Mean velocity on a level .... 30·93.

Mr. Parkes falls into this error, because, in speaking of *fuel*, it is said, in our *Treatise on Locomotive Engines* (page 324, 1st edition, and page 311, 2nd edition), that when the engines ascend without help one of the two inclined planes of the Liverpool and Manchester Railway, the surplus of work, thence resulting for them, equals, on an average, the conveying of their load to about $\frac{1}{6}$ more distance; that is to say that the engine will, in that case, consume as much *fuel* as if it had conveyed an equal load to a distance greater by $\frac{1}{6}$, on a level. And the *critic* thence logically concludes (page 86) that the *velocity* must be by so much increased, without perceiving that this correction refers only to the *work* done, and, as a consequence, to the corresponding consumption of fuel, but not to the *velocity*, which would suppose, not only that the load has been conveyed to $\frac{1}{6}$ more distance, but, besides, that it has been conveyed there *in the same time.*

Respecting this mistake, we have also proved that the error of Mr. Parkes has the double consequence of increasing the pretended effect produced, and lowering the pretended pressure of the steam in the cylinder; so that the proportion between the power applied and the effect produced is made doubly erroneous, and introduced so in his tables.

All this is certainly undeniable, and rests upon tables and facts only, not upon sentiments, and when we say that the *whole* of the calculations and tables of Mr. Parkes are grounded upon those mistakes, it cannot be denied either, in looking only at table viii. col. 10, table ix. col. 19, table xiii. col. 9, table xiv. col. 3, table xvi. col. 2. It will be there seen that *every other column is depending upon the alleged velocity of the engines.* Therefore, we are right when we conclude that the volume and pressure of the steam consumed by the engines (table ix. col. 26, 29), the horse power produced per cubic foot of water vaporized, or the quantity of water and coke employed to produce one horse power (table x. col. 44, 45, 49, &c.), the *momenta* generated per second (table xiii. col. 11, 12, table xiv. col. 9, 10, 11), and finally all the consequences derived from the comparison of the results obtained in those tables, about the alleged inaccuracy of the experiments, or the respective effects of locomotive and fixed engines, are in every way erroneous.

To show, by a particular example, the fallacy of the results to which Mr. Parkes has been led by this wholesale and faulty way of calculating, with a wrongly averaged and greatly exaggerated velocity, without taking account of the gravity, or of any of the other resistances really encountered by the engines, we refer to the two experiments of *Fury*, of which Mr. Parkes says (page 128), "a reference to the *Fury* (previously adverted to as giving anomalous results) exhibits that engine as having performed more work at 23 than at 21$\frac{3}{4}$ miles per hour, by the ratio of 24 to 19; it is therefore with certainty we may conclude one or both of those experiments to be erroneous." We have shown that this consequence presented by the *critic* with such certainty, proceeds only from his having neglected to consider that one of the experiments was made from Manchester to Liverpool, and the other, on the contrary, from Liverpool to Manchester. But, on account of the general rising of the road from Manchester towards Liverpool, the gravity opposes more resistance in that direction than in the other. So that, although the load of the engine was lighter in the first trip, still there was more work required of the engine, to convey that load to the other end of the line. In fact, in making the calculation as it ought to be, that is to say in taking account of the gravity *overlooked by Mr. Parkes*, it is found that, in the trip made from Manchester to Liverpool, the work done by the engine amounted to conveying 1964 tons to one mile, or 65·5 tons to 30 miles, on a level, and in the other trip, to 1837 tons to one mile, or 60·6 tons to 30 miles, on a level. Therefore the engine ought to have employed more time in performing the first trip than the second, which, concurrently with the other errors of computation of Mr. Parkes, had led him to conclude with "certainty" these experiments to be erroneous.

3rd. Mr. Parkes (pages 82, 83) says, "the pressure deduced from the sum of the resistances, given in column 29, for M. de Pambour's experiments I. to X, is composed, 1st of the friction of the engine without load, which includes the resistance opposed to it as a carriage, in common with the train; 2ndly, of the additional friction brought upon the engine by the load; 3rdly, of the resistance of the load at 8 lb. per ton. According to the author, these three items include all the resistance overcome by the steam, excepting that occasioned by the blast, in excess over the atmosphere. The amount of the latter should, therefore, be ascertainable by comparing the whole force exerted by the steam on the piston, with the force assigned as requisite to overcome the aforesaid three, out of the four component parts of the total resistance. The difference between these pressures should represent the precise amount of the counter elasticity of the steam in the blast-pipe." So, it is clear, as we have said in our former paper, that Mr. Parkes calculates the pressure owing to the blast-pipe, merely by taking the difference between the valuation of the divers resistances and *his own* result of the pressure of the steam in the cylinder. Now, we have already proved that this last result, obtained by Mr. Parkes as representing the pressure in the cylinder, is altogether erroneous. Therefore his supputation of the pressure in the blast-pipe must equally be so. But, besides, it is evident that such a mode of proceeding, by merely taking the difference between two assumed quantities, to establish the value of a third unknown, could never give, for this one, a value sufficiently certain to make it the test of experiments and *facts;* since every thing neglected in the calculation, like water lost by *priming*, resistance of the air, gravity, &c. would necessarily pass to the account of the pressure due to the blast-pipe, and falsify it. Consequently, if, by this calculation, Mr. Parkes is led to very inaccurate results, he ought not to be astonished, and we are not certainly.

4th. Mr. Parkes (pages 98, 99), in speaking of our two experiments made with the engine *Leeds*, says: "the author also has informed us that in the two experiments, the pressure in the boiler was precisely the same, and the regulator opened to the same degree. The power applied in the two cases was, consequently, precisely equal, and equal weights of water as steam passed through the cylinders in equal times; whence it results that the effects should have been similar. The expenditure of power was, however, greater by more than a third in the second than in the first case, to produce like effects, for we see that the effective horse power required 85·43 lb. of water as steam in the second and only 60·94 lb. in the first." And (page 100), "if, as asserted,

the pressure in the boiler were precisely the same, and the regulator opened to the same degree in the second as in the first experiment, equal power must have been generated and expended in the same time, though at the higher velocity, the lighter load was moved through a greater space in that time. Had M. de Pambour reduced his data to the terms of value in these tables, he must inevitably have discovered the numerous errors of fact, and deduction, which are now brought to light."

So, it is clear that we did not misrepresent the sentiments of Mr. Parkes when, in our former paper, we said that he concluded against the accuracy of the experiments, because in the two cases cited, the useful effects of the engine had not been the same. But we have proved, in that paper, that in spite of an equality of pressure in the boiler and of opening of the regulator, there is always more loss supported by the engine, in overcoming its friction, the resistance of the air, &c., at a great than at a small velocity. Therefore, the useful effect produced, or *effective horse power* ought not to be *similar* in the two cases; and the "numerous errors of fact, and deduction, which are now brought to light," by the *Critic* and his tables, are nothing but a new misconception.

5th. We have said that Mr. Parkes submits the two same experiments, and the other experiments afterwards, to the test of a new principle, which consists merely in his making a confusion between the vaporizations effected in traversing the same distance and the vaporizations effected during the same time. This will be proved by the following passage, in which it will be seen that Mr. Parkes quotes our words relative to the vaporization *for the same distance*, and afterwards applies them to the vaporization *in the same time*. We have marked in *italics* the words which make this misreasoning quite evident. He says (page 99), "in his *Treatise on Locomotive Engines*, (pages 310, 312), M. de Pambour states a near parallel to these two experiments, by supposing a case of the same engine, with the same pressure in the boiler, travelling *the same distance* with two different loads. *The distance travelled being the same*, the number of turns of the wheel, and consequently of strokes of the piston, or cylinders of steam expended will be the same in the two cases.... So the mass or weight of steam expended will be in each case in the ratio of the pressure in the cylinder.... Now the author has given us the resistances on the piston which amount in the first case to 38·43 lb., and in the second to 23·93 lb. per square inch; and yet he assumes an equal expenditure of water as steam, *in equal times*, in the two cases.... To be consistent, however, with his own rule, above quoted, viz. that the weight of water consumed as steam are to each other as the resistances on the piston, it is obvious that if, in the first case, 3026 lb. of steam passed through the cylinders *in an hour*, 2166 lb. only would have been expended in the second case." And (page 101), "But we have already seen that if the quantity of water were correctly taken in the first case, a less quantity must have been consumed in the second, as the load upon the pistons of the engine in the two experiments deduced from their velocity and assigned resistances, differed in the ratio of 38·43 to 23·93; *and the water as steam consumed, in equal times, must necessarily have varied in the same ratio*, or as 3026 lb. to 2166 lb. It would be fruitless to pursue this analysis further, and vain to attempt the rectification of errors,—a task which properly belongs to the author."

We see that the passage quoted from our work establishes distinctly that when an engine draws two different loads over the same ground, the quantity of water vaporized, *for the same distance*, must be in proportion to the total pressures of the steam in the cylinder. But Mr. Parkes concludes from it, that the quantities of water vaporized, *in the same time*, must be in the ratio of the pressures. But we have proved, in our former paper, that those two consequences are precisely contrary to each other. Therefore the principle alleged by Mr. Parkes, and which he uses afterwards throughout his paper, to "test" the accuracy of the experiments, rests merely upon a new mistake of his own, which consists, as we have said, in making a confusion between the vaporization *for the same distance*, and the vaporization *for the same time*. So that there is no occasion to "attempt the rectification of errors" discovered by the application of this *new* principle.

6th. Mr. Parkes comparing the locomotive with the fixed engines, says, (page 90), "Thus the fixed non-condensing engine is the most economical of the two; but if Mr. de Pambour's data are correct, we must abandon all preconceived opinions, and all belief in the accuracy of pre-ascertained results on the non-condensing engine; we must reverse our engineering creed, and acknowledge the fixed non-condensing engine, with its simple atmospheric resistance, to be far inferior, in economy of steam, to the locomotive, with its plus atmospheric resistance." And (page 98), "for it is utterly impossible that the locomotive should accomplish an equal effect, with $\frac{1}{3}$ less steam than the condensing engine. To go over this ground again would be a mere repetition of arguments previously used."

By these passages it is fully established that Mr. Parkes would, as we have said in our former paper, conclude against the accuracy of the experiments, because a locomotive engine cannot possibly produce a useful effect equal to that of a high pressure non-condensing, or to that of a condensing engine. But we have proved that the case may occur; and Mr. Parkes concedes it himself (pages 156, 157), in saying of a sort of locomotive engine under his charge, "the consumption of steam per effective horse power, per hour, has been shown to be 120 lb. for the fixed non-condensing engine, and for the locomotive under review 112·54 lb., which proves the latter to have been the most economical of the two, at nearly the same absolute pressures. This is a new, and perhaps, an unexpected result." Therefore Mr. Parkes's first objection was good for nothing. But, besides, it must be borne in mind that the velocities used by Mr. Parkes, to calculate the effects of the locomotive engines, being nearly all considerably increased, as has been proved above, he must necessarily arrive at exaggerated results for the effects which he supposes to have been produced by those engines. Therefore this new argument against the accuracy of the experiments, is again the result of his own errors of reasoning and calculations.

7th. To prove that the same unfounded arguments have been urged by Mr. Parkes, and with the same results, against every other engineer who has published experiments on locomotive engines, we need only quote the following passages.

Respecting the experiments of Mr. *Robert Stephenson*, Mr. Parkes says (page 105), "They contain within themselves abundant proofs of error in the quantities assigned to the consumption of water as steam.... Now, if the evaporative data are correct, it would appear by the ratio which the volume of steam consumed bears to that of the water which produced it ($\frac{1}{20}$th being deducted for waste), that the absolute pressure upon the pistons in this case amounted to 81·95 lb. per square inch; but there was only 50 lb. in the boiler! If, therefore, 77 cubic feet of water passed through the cylinders in an hour, in the shape of *pure* steam, the blast-pressure or counter-effort above the atmosphere, was 34·41 lb. instead of $2\frac{1}{2}$ lb. per square inch on the pistons." And (page 106), "Experiment XII. In this case I have assumed an equal evaporation in the same time as in the foregoing experiment; and if $\frac{1}{8}$ were deducted for waste, the blast-pressure would be less than nothing—or a vacuum; for, with the subtraction of $\frac{1}{4}$ for waste, as in the table, the absolute pressure amounts only to 11·10 lb., whilst the resistance required 10 lb. per square inch; and if, contrary to demonstration, it be considered possible that the 77 cubic feet of water were converted into pure steam, and that this quantity passed through the cylinders in the hour, the blast-pressure would equal the whole force required to balance the assigned resistance; for the absolute pressure on the pistons would have amounted to 20·70 lb. per square inch, whilst the sum of ascertained resistance was only 10 lb."

Respecting *Dr. Lardner's* experiments, Mr. Parkes says, (page 110), "It appears, from the tenth conclusion, that the author considers his experiments, so far as they have gone, as giving results in very near accordance. It cannot fail to be remarked that the term discordance would seem to be much more appropriate than accordance to the indications of the last column in the table. But no fair average can be struck from such irregular results; and (page 118), "If the resistance assigned by Dr. Lardner as opposed to the motion of the train be correct, the efficiency of the steam in the locomotive is more than double that obtained by the best condensing engines, more than treble that derived from stationary non-condensing engines, and equal to the performance of a Cornish expansive engine doing a 50 million duty with a bushel of coals."

Respecting the experiments of Mr. *Nicholas Wood*, Mr. Parkes says, (page 129), "The *North Star* affords a sequence of six experiments at velocities varying from $18\frac{1}{2}$ to $38\frac{1}{2}$ miles per hour, but the sequence of results is so irregular as to indicate error in two of them, which I have accordingly marked and rejected, for it is certain that a greater measurable effect must accrue from the expenditure of equal power at 25 than at 30, and at $31\frac{1}{2}$ than at 34 miles per hour; yet the reverse appears on the face of the experiments. It is also equally impossible that a greater momentum should have been generated by a like consumption of force at 34 than at 25 miles per hour."

Respecting the experiments of Mr. *Edward Woods*, with the *Hecla*, Mr. Parkes says, (page 117), "On turning to the tables, and examining the results of this experiment (case 2), it will be apparent:

"1. That a duty has been performed of double the amount effected by the condensing engine, with an equal expenditure of power (column 15).

"2. That the absolute force impressed upon the pistons, as determined by the relative volumes of water and steam was 30·95 lb. per square inch, whereas the tractive effort requisite to overcome the assigned resistance, amounted to 39·28 lb. per square inch, exclusive of the force equivalent to the friction of the loaded engine and blast pressure (cols. 29, 30).

"3. That the power required of the engine to balance the tractive effort alone was $151\frac{1}{3}$ horses, whilst the absolute power furnished by the steam to move the engine, to neutralize the blast resistance, and to overcome the load, amounted only to $119\frac{1}{2}$ horses (columns 33, 34).

"4. That the water expended as steam per horse power per hour, was 37·89 lb. for the tractive effort or duty only (column 42), whereas the condensing engine consumes 70 lb. per effective horse power.

"5. That compared with a fixed non-condensing engine at equal pressure, the locomotive, though labouring against the heavy counter pressure of the blast, from which the other is free, is assumed to have performed equal work, with less than one-half the expenditure of power.

"Such are the incredible results arising out of data purporting to be fairly and necessarily deduced from impeachable experiments."

Therefore we were quite justified to say in our former paper, that it was remarkable that in applying his pretended verifications to all the experiments published on locomotive engines by different engineers, Mr. Parkes had found that the conditions to which he proposed to subject those experiments were not verified in them, and that such a result ought to have put him on his guard against the soundness of his own arguments. But, besides, we have proved that Mr. Parkes has used, in all his calculations, velocities which are erroneously averaged and greatly exaggerated; that he has taken no account of the gravity on the different inclinations of the road; that he has neglected the friction of the engines, the resistance of the air, &c.; that he has calcu-